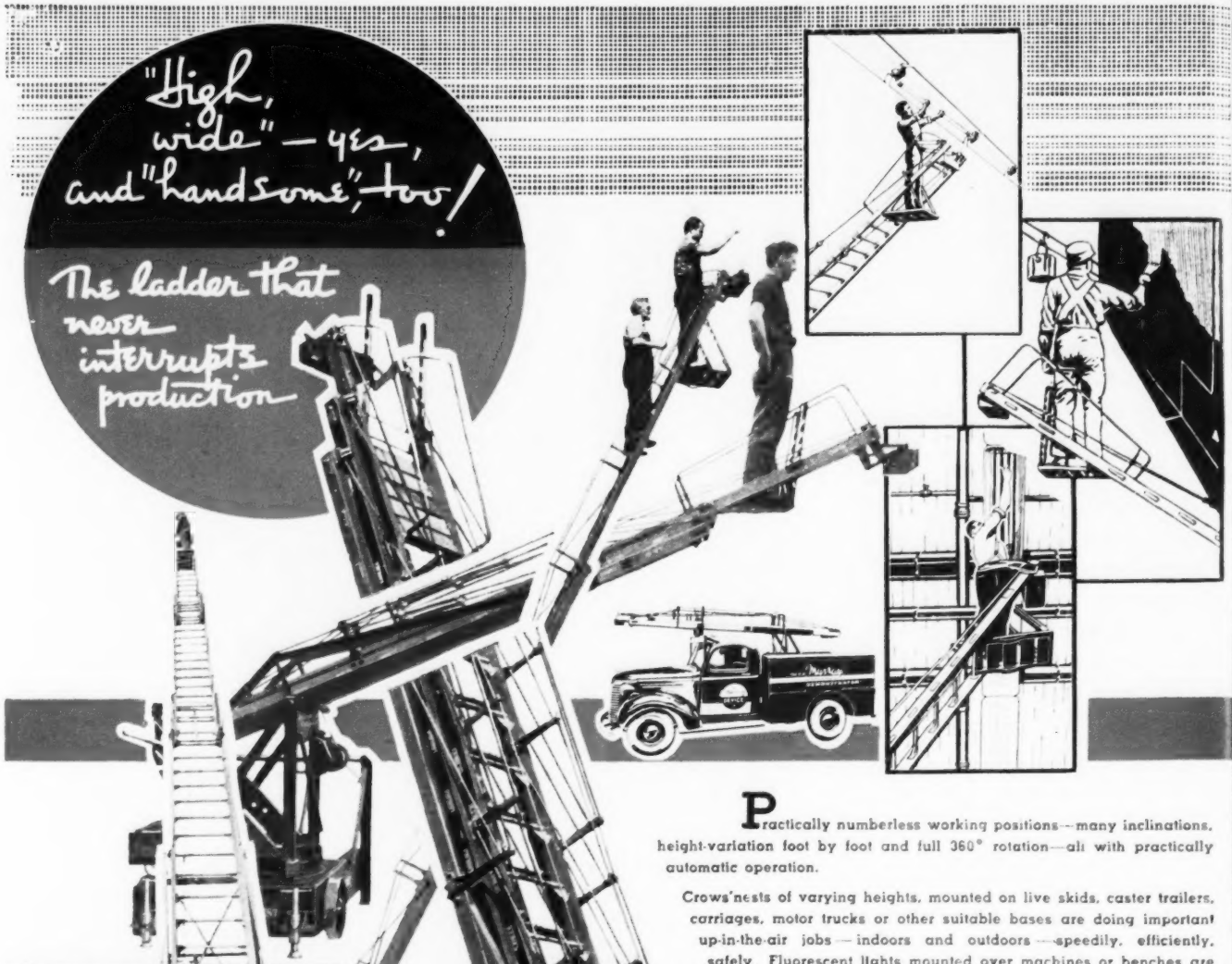
Electrical World

JANUARY 20, 1945

Annual Statistical Number

"High, wide" — yes, and "handsome", too!

The ladder that never interrupts production



Practically numberless working positions—many inclinations, height-variation foot by foot and full 360° rotation—all with practically automatic operation.

Crows'nests of varying heights, mounted on live skids, caster trailers, carriages, motor trucks or other suitable bases are doing important up-in-the-air jobs—indoors and outdoors—speedily, efficiently, safely. Fluorescent lights mounted over machines or benches are serviced without interrupting production.

Crows'nests are mighty useful, too, for inspecting, building, servicing and repairing planes in nearly every manufacturing plant and at airport after airport. For proposal, specify working height, sideways-reach and aisle-width, if any. No obligation. Metropolitan Device Corporation, Brooklyn 16, N. Y.

Send for informative technical data

Murray crows'nest

ACCLAIMED AMERICA'S No. 1 MAINTENANCE LADDER — *for indoors and outdoors*

Electrical World

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January 20, 1945 — Vol. 123, No. 3

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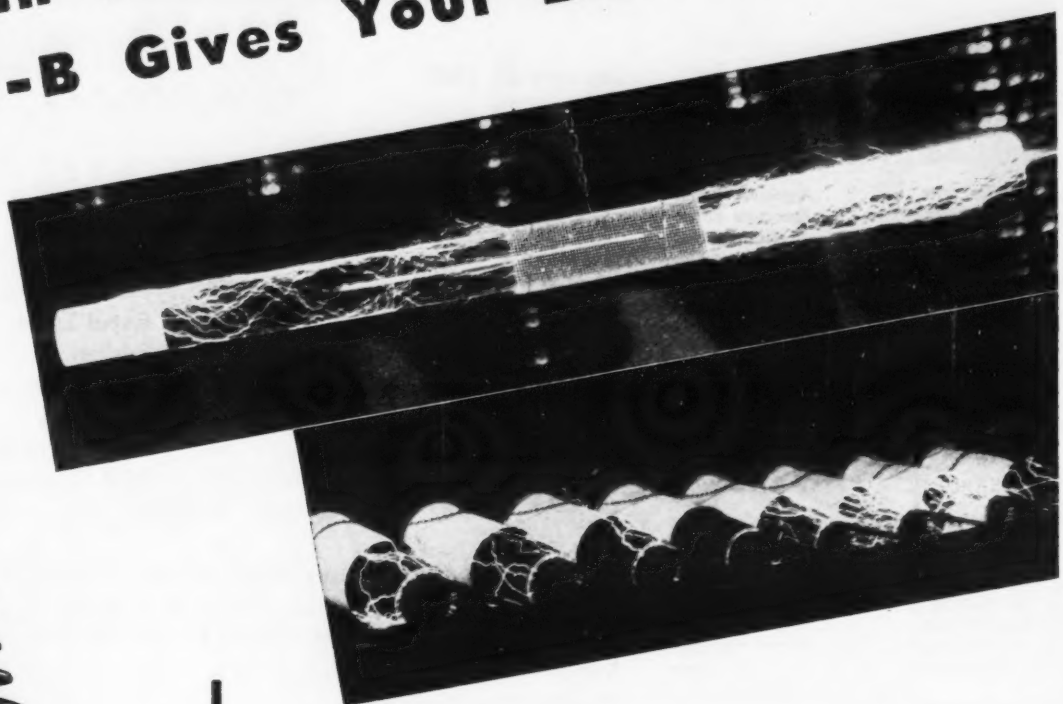

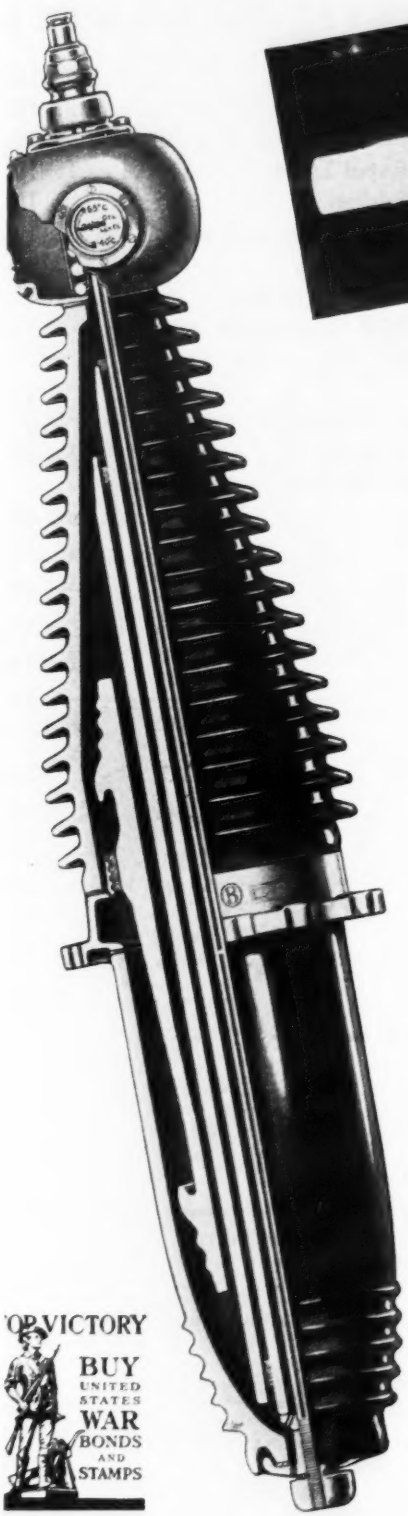

IN BUYING a critical piece of insulation like a bushing, you have a vital interest in what the manufacturer knows about it--not what he knows about the subject in general so much as what he knows about *that bushing* in particular, from a standpoint of inspection and tests...O-B has an exclusive advantage here. Using porcelain as an internal dielectric, it can be subjected to over-voltage without harm. Each component O-B part must withstand three minutes of continuous, 60-cycle flashover before assembly. Such testing will seek out the slightest flaw. Passing such a test is a positive assurance of soundness...Every O-B bushing you get has withstood this routine proving test, whose severity would destroy a less substantial dielectric than porcelain. O-B knows a lot about *that particular bushing* you buy; we know it will duplicate the outstanding service performance of thousands of others like it. It has been tested piece by piece. That's what you buy when you specify O-B.

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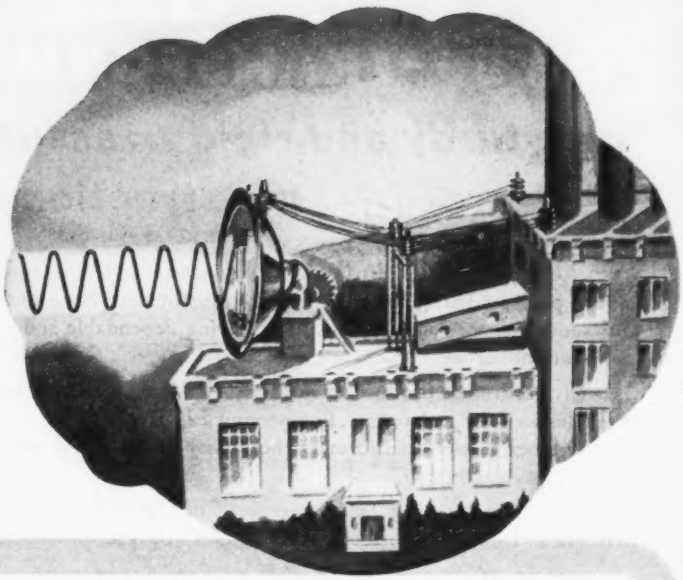

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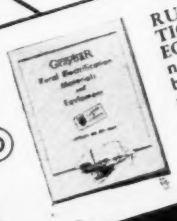

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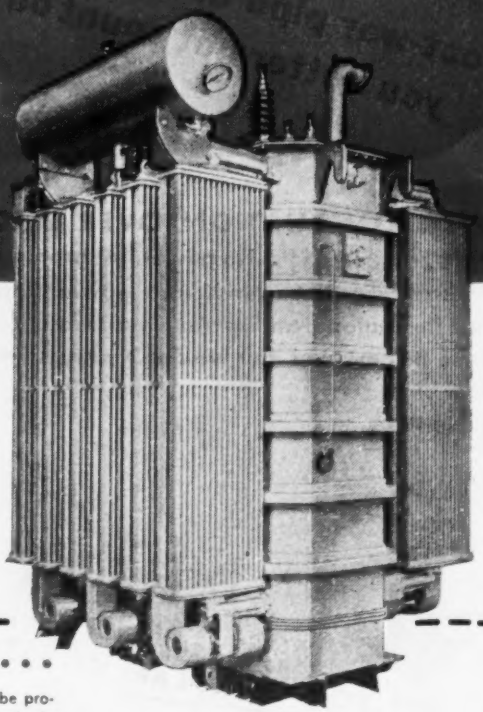
are sturdy and rigid... assuring users *plus* construction—



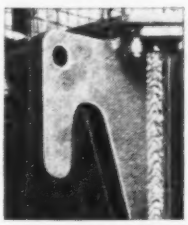
In the past 50 years, Wagner power transformers have established outstanding performance records in supplying dependable and unfailing continuity of service.

Carefully controlled production methods... Highest quality materials... Rigid inspections and tests... Engineering experience... all combine to give Wagner power transformers the ability to take real punishment and still stay on the job.

Illustrated and described below are some of the construction features that make these transformers the "huskies" of the power industry.

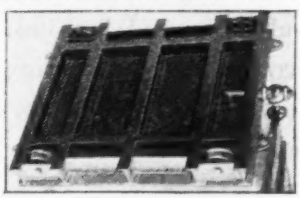
STUDY THESE CONSTRUCTION FEATURES...

WELDING



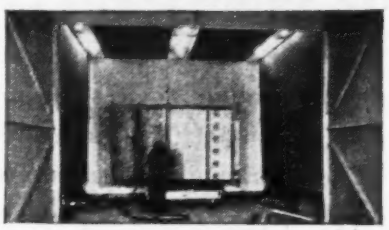
All seams are electrically welded inside and outside, and in some of the larger tanks a total of four welds are used to assure strong, leakproof joints. Note the heavy steel lift hooks. They are solidly welded to the transformer just below the top section of tank. The holes in the lugs provide a means to attach cables to assure safety in shipment.

BASE CONSTRUCTION



The base is formed from exceptionally heavy steel-plate. On small tanks, the base is folded and welded to furnish the under-support. On large tanks, heavy structural-steel channels and angles are welded to the sheet-steel base. When specified, tanks can be provided with wheels or trucks, flanged or flat wheels, railroad-gauge or otherwise. Tow lugs are provided on two sides of the base to permit pulling transformer into position.

SAND BLASTED



After the welding operations are completed, each transformer tank is "sandblasted" with steel grit. This removes all plate and welding scale, providing a clean, solid base so the paint will adhere and thoroughly cover both the inside and outside surfaces of the transformer.

FLOW COATED

The tanks of all Wagner power transformers are flow-painted. This process assures complete coverage with a uniform coating of paint. Three coats of paint are applied—a primer coat, a bonding coat, and a heavy finishing coat.

BAKED

After each coat of paint has been applied the tank is thoroughly baked in special bake ovens. The care taken in painting and baking the tanks of all Wagner transformers assures an absolute weather-resisting outside surface. The special paint used on the inside of the tanks will not disintegrate or act as a catalytic agent to cause transformer oil to deteriorate.

TESTED

All tank covers, bushing mounting-flanges, radiator connections, and all welded seams are pressure-tested to insure absolute leakproof construction. All welded joints of mounting bosses are tested with a very thin fluid at a pressure of approximately 350 pounds per square inch. Any defects in the welded joints are thereby quickly and unfailingly discovered.

REINFORCED TANK SHELL

The tank shell is fabricated from Heavy steel plate and the entire tank body is given added reinforcement by the addition of structural shapes welded to the outside of the tank, forming a homogenous, mechanically strong structure that will not twist or bend under heavy strains.

TRANSFORMERS
are but one of several WAGNER PRODUCTS serving industry.

Other WAGNER PRODUCTS:
AIR BRAKES
BRAKE LINING
HYDRAULIC BRAKES
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INDUSTRIAL BRAKE CONTROLS
TACHOGRAPH (Recording Speedometer)
ELECTRIC MOTORS

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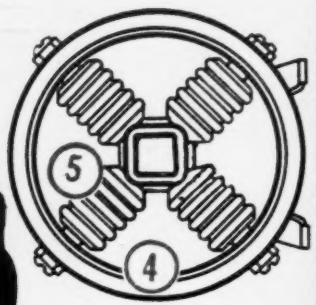
Wagner maintains branches in 29 principal cities. These branches are manned by trained field engineers who will gladly work with you and show how you can benefit by installing Wagner Transformers.

T45-2

Wagner Electric Corporation
ESTABLISHED 1891
6456 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

CHECK the FACTS

1. Individual switch housings, sealed and dustproof, isolate phases and prevent interphase shorts. Removable covers simplify routine inspection.
2. Hi-Pressure, self-cleaning silver spot contacts at jaw end.
3. Annular Hi-Pressure silver ring line contact at hinge end.
4. Supporting ring frames equalize all stresses. Mounting can fit any position required.
5. Porcelain in compression is used to best advantage.



Shown here is a three pole, 4000 Amp., group operated, isolated phase disconnecting switch.

The Check List

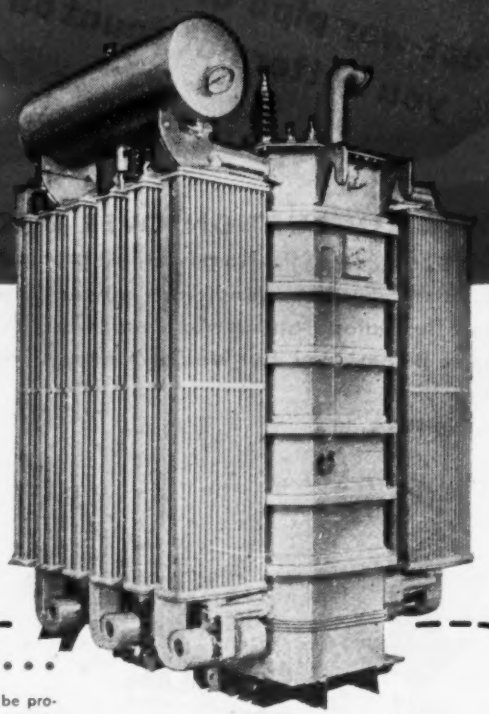
- CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- HORN GAP SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED, ISOLATED PHASE DISCONNECTING SWITCHES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SECTIONALIZING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

R&IE

Isolated METAL ENCLOSED DISCONNECTING SWITCHES

RAILWAY AND INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.
IN CANADA—EASTERN POWER DEVICES, LIMITED, TORONTO

Wagner
POWER TRANSFORMERS
are sturdy and rigid . . . assuring users *plus* construction—



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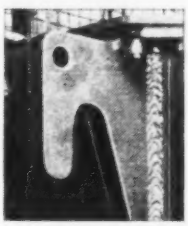

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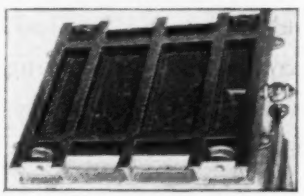

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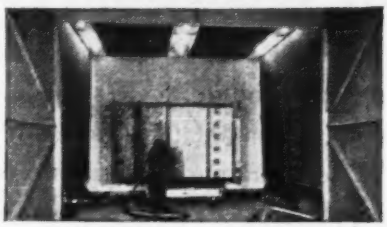

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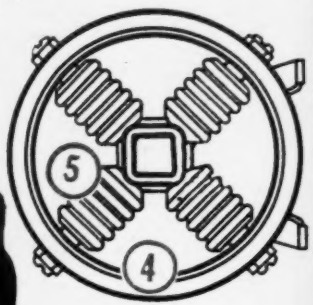

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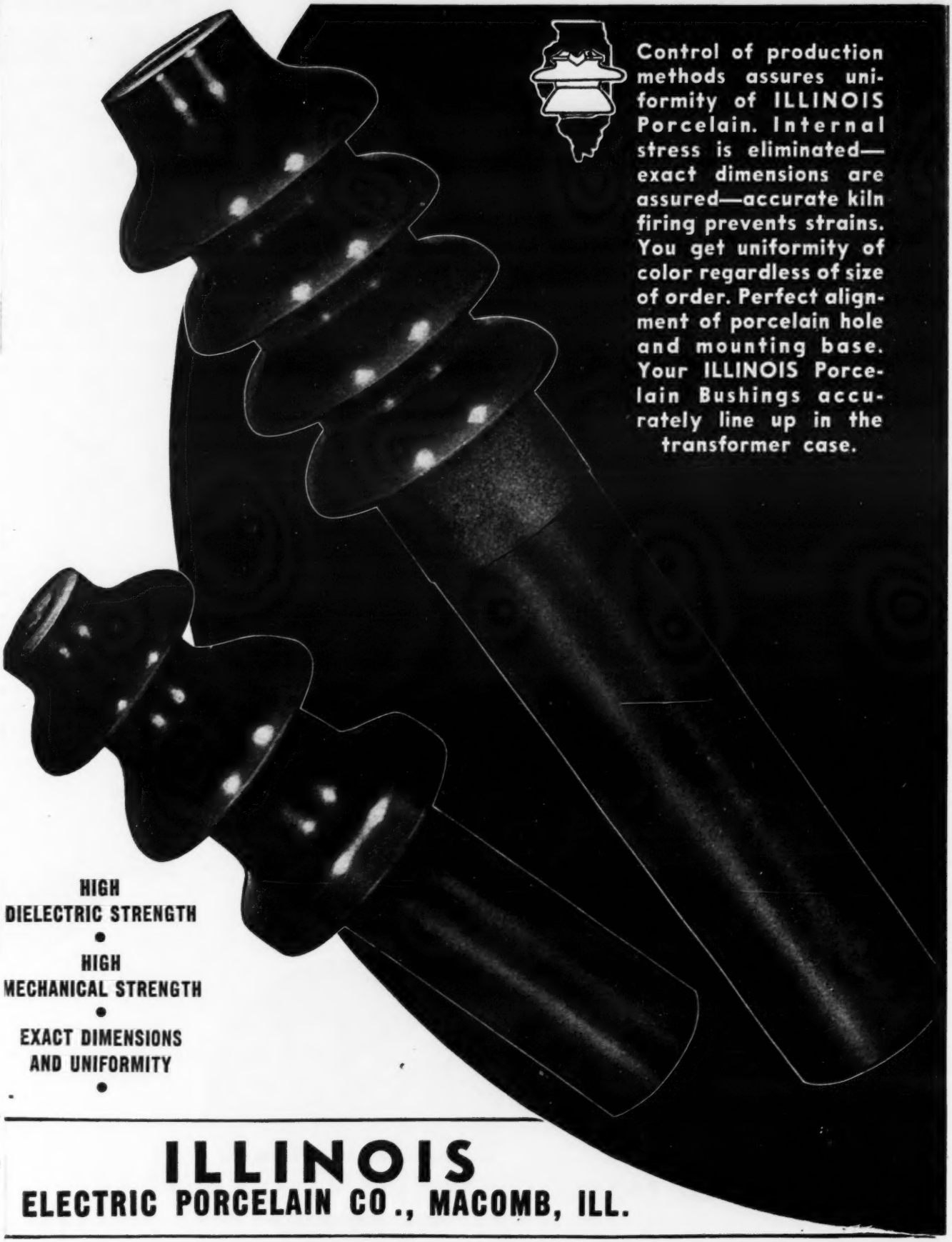
You Get Uniformity In

ILLINOIS PORCELAIN BUSHINGS



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HIGH MECHANICAL STRENGTH

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EXACT DIMENSIONS AND UNIFORMITY

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ILLINOIS
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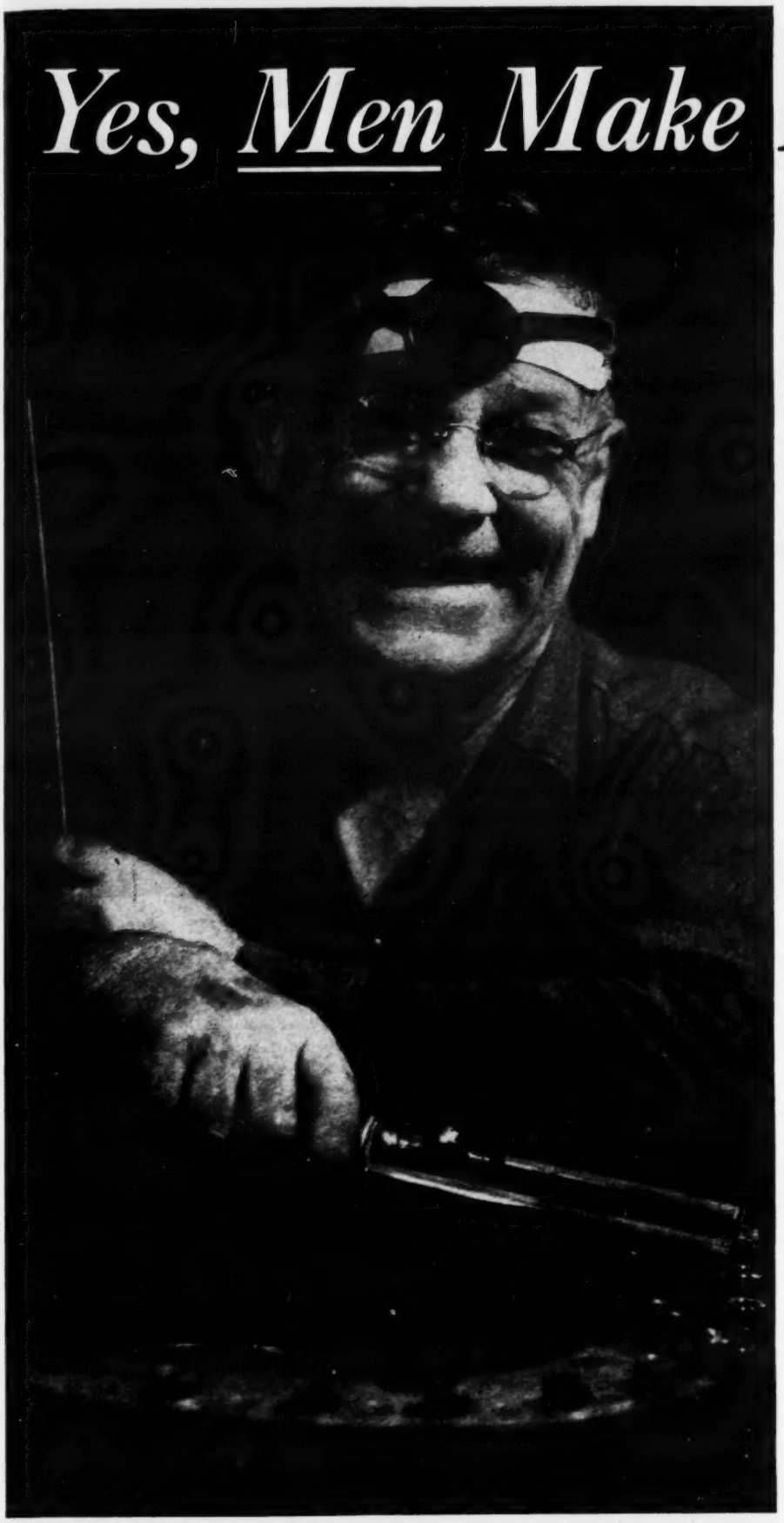

NO MACHINE KNOWN can duplicate the skill of Sam Meister, left, of Allis-Chalmers Norwood Works.

Holding an acetylene torch in his right hand, a silver alloy rod in his left, Sam silver-brazes end connections of Allis-Chalmers' "Indestructible Rotor."

Round and round the connections he works — expertly flowing in molten alloy to form a joined structure that can withstand as much heat as though it were a single die-casting.

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Next time *you* need great motors contact our district office. Or write direct to ALLIS-CHALMERS MILWAUKEE 1, WISCONSIN.

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Compare new Ampac A-C WELDER with:

D-C WELDERS..

▶ Unlike d-c welders, Ampac a-c welder has *no arc blow!* That means welding speed is increased 15 to 30% on heavy work.

▶ Transformer type construction of a-c Ampac has both higher efficiency and lower idling loss than comparable m-g type welder.

▶ At no load the Ampac "400" idling loss is 200 watts—the idling loss of a typical m-g 400 amp d-c welder is 3100 watts. At 2¢ per kw/hr, the d-c unit wastes $1.49 in a full 24-hour day — Ampac's loss is less than 10¢!

▶ Initial cost of Ampac is lower — about 1/3 less than for a comparable d-c welder.

▶ Ampac's maintenance is lower because there are only three moving parts on the whole welder. There are *no* brushes to change—*no* commutator to dress.

▶ One control regulates entire welding output on Ampac a-c welder. Most d-c units have two or more controls. Result: Ampac saves adjustment time, helps speed production.

▶ Ampac can be used on any standard a-c voltage — 220-440 and 208 v, 60 cycle . . . without the extra expense of 3-phase installation as required by d-c welders.

OTHER A-C WELDERS..

▶ On Ampac — and Ampac alone — voltage is *automatically* raised for ideal arc striking at low currents. That provides perfect welding characteristics over entire range.

▶ Ampac's 3-piece core arrangement is exclusive among a-c welders. Provides basis for Ampac's high efficiency and low idling loss. Compared with the two largest selling 300 amp a-c welders, idling loss of the new Ampac "400" at no load is 14% lower than one, 61% lower than the other.

▶ Complete welding range is covered in only seven turns of Ampac's control wheel.

▶ Unlike many a-c welders, Ampac has handles, crane hooks and welding terminals that attach *directly* to the core. Case acts *only* as a protective shell. Damage to case cannot harm structure of electrical parts within.

▶ Ampac has no stray flux to heat up the case. Reactor coil surrounding the variable air gap forces every line of flux into active duty.

▶ Ampac "400" is the ideal size a-c welder. It's large enough to use 1/4" rods, 24 hours a day — which 300 amp units will *not* do. And the average 500 amp unit is rarely used at over 450 . . . while Ampac range is 50-500 amps.

♪ *Tune in the Boston Symphony, Blue Network, every Sat. Eve*

GET COMPLETE FACTS on this great new Ampac a-c welder from your nearby Ampac dealer or Allis-Chalmers district office. Learn how its patented circuit cuts costs — increases production. Ask for bulletins B6241, B6302.

ALLIS-CHALMERS
MILWAUKEE 1, WISCONSIN

A 170

then he said to himself

"I'M SITTING TIGHT"

REPLYING to America's early proposals and assurances that the United Nations had no designs on Spanish territory, Dictator Francisco Franco defended his neutrality with:

> "I will avoid anything which might disturb our relations in any of their aspects."

Sitting tight in any business is one of the easiest things a man can do.

The only trouble is that in this era of quick advances, sitting tight doesn't get one anywhere—but down—and fast.

And when the dust of the passing parade clears—it's a long, plodding process to catch up.

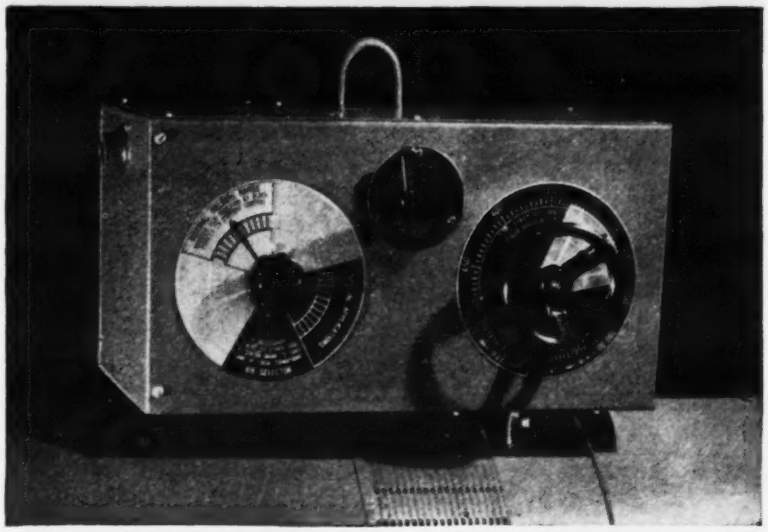
We see it well expressed in many "Stand pat" companies now making *no* plans for improving their welding methods—either in new production techniques or the latest welding equipment.

And others . . .

"SITTING TIGHT," *he says*

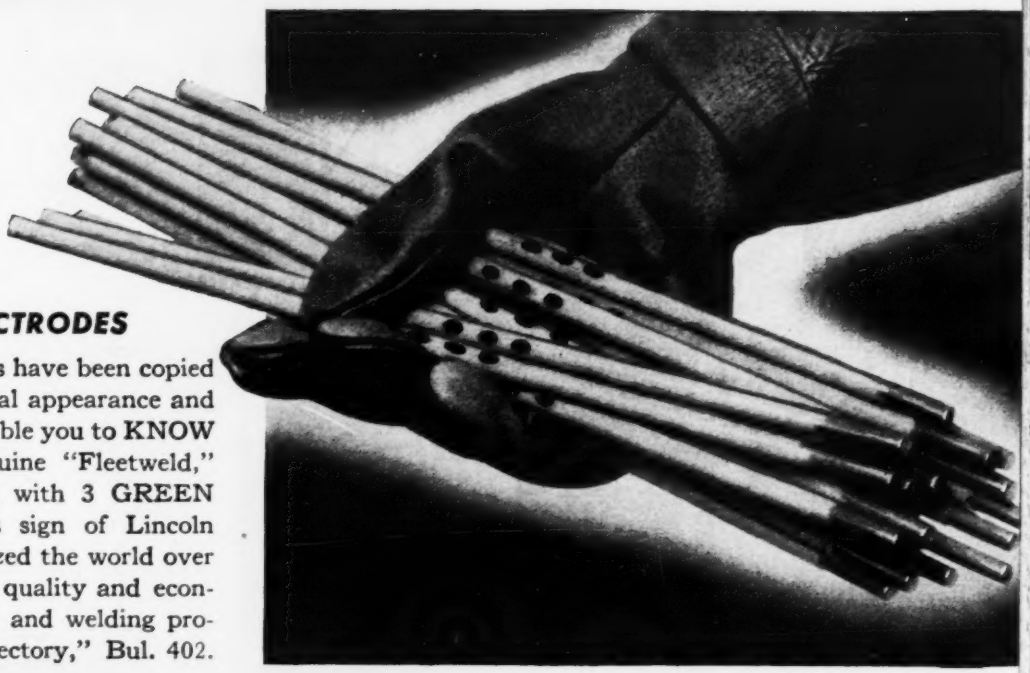
Look, Francisco . . . here is the wherewithal to step out in front with Arc Welding:

THE TOOLS FOR NON-STANDPATTERS



"SHIELD-ARC" WELDER

The "Job Selector" of the Lincol "Shield-Arc" Welder permits selection the TYPE of welding arc . . . a predete mined welding characteristic . . . to mat the job. Its Current Control provides ar desired amperage over a wide range. Bo selectors are Self-Indicating for KNOW results . . . unmatched speed, ease ar economy of welding. The "Shield-Ar is recognized the world over for its s periority 32 ways . . . described fully Bul. 412.



"FLEETWELD" ELECTRODES

These world favorites have been copied extensively as to general appearance and color of coating. To enable you to KNOW that you get the genuine "Fleetweld," they now are marked with 3 GREEN DOTS. Look for this sign of Lincoln Electrodes . . . recognized the world over for their superiority in quality and economy. Complete details and welding procedures in the "Weldirectory," Bul. 402.

THE LINCOLN ELECTRIC COMPANY • CLEVELAND 1, OHIO

America's greatest natural **recourse**

ARC WELDING

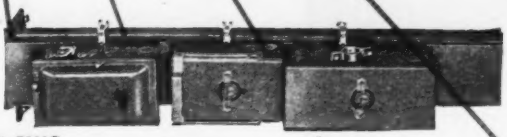
TRUMBULL

DISTRIBUTES · · CONTROLS · · SAFEGUARDS · ·

ELECTRICITY FOR LIGHT AND FOR POWER

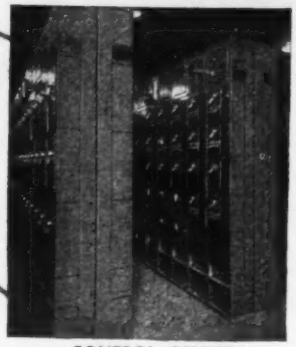
Trumbullist, a general catalogue of Trumbull products with essential illustrations, is published once or twice a year. We shall be glad to have your name on our list to receive this Trumbull publication.

L. V. D. (LOW VOLTAGE DROP) MAIN FEEDER SYSTEM



FLEX-A-POWER AND FLEX-A-PLUG PLUG-IN SYSTEM

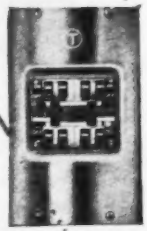
SMALL MOTOR STARTERS



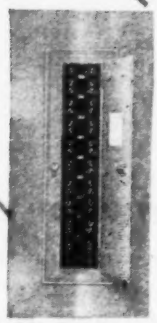
CONTROL CENTERS

HEAVY DUTY INDUSTR'AL SWITCHES

MANUAL STARTERS

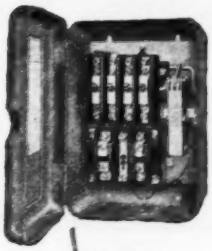


MULTI-BREAKERS

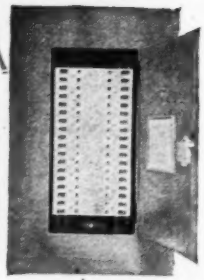


SWITCH AND FUSE LIGHTING PANEL BOARDS

CIRCUIT BREAKERS

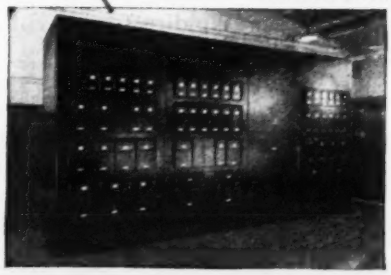


MAGNETIC STARTERS



MULTI-BREAKER PANEL BOARDS

SWITCH BOARDS



THE TRUMBULL NAME PLATE IS KNOWN TO ELECTRICAL MEN IN EVERY BRANCH OF THE FIELD.

Trumbull products cover an unusually comprehensive assortment of material for complete systems of interior electrical distribution and control. This advertisement features only the principal broad groupings of these products. Trumbullaid circulars and bulletins available on request.

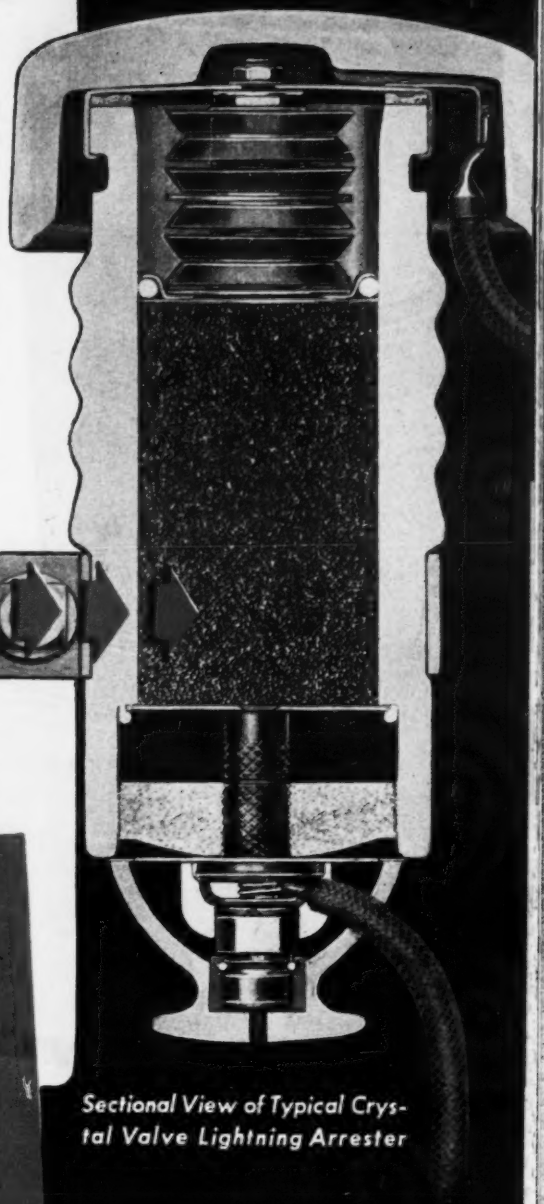
TRUMBULL ELECTRIC MANUFACTURING COMPANY • PLAINVILLE, CONN. • A GENERAL ELECTRIC ORGANIZATION

OTHER FACTORIES AT NORWOOD (CINN.) O. – SEATTLE – SAN FRANCISCO – LOS ANGELES

No material so far developed for the valve element of lightning arresters has all of the advantages and all of the characteristics so definitely outstanding as does . . . .

OXIDIZED
Silicon Carbide

Used only and exclusively in Crystal Valve Lightning Arresters



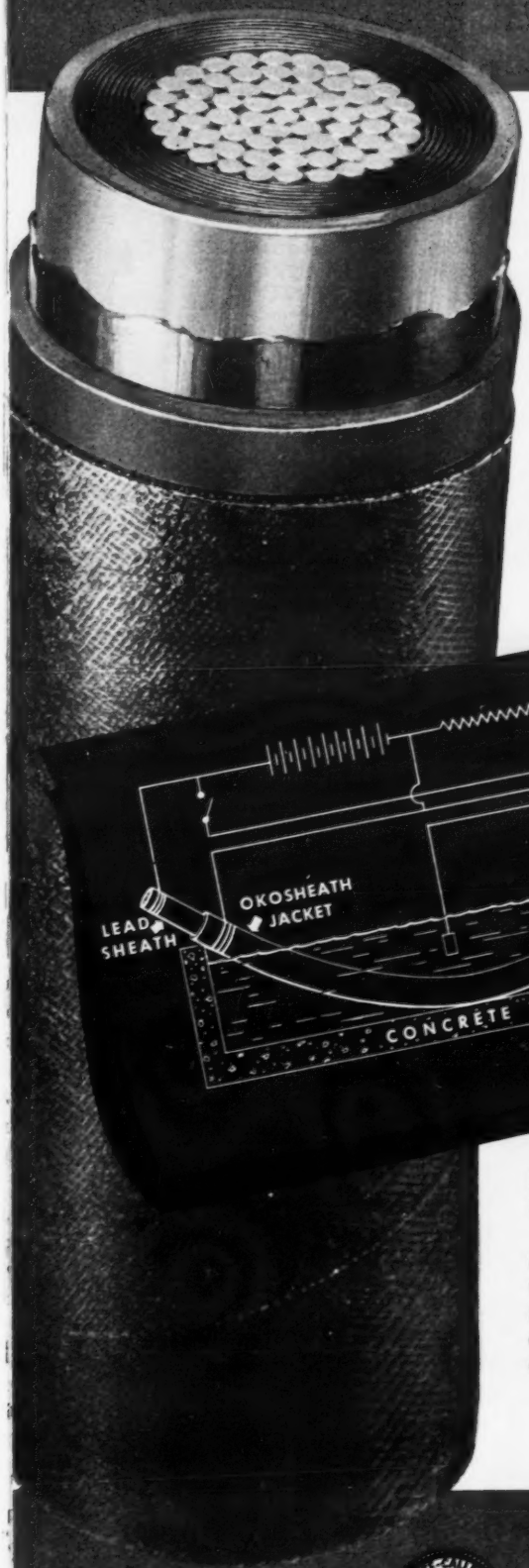
Sectional View of Typical Crystal Valve Lightning Arrester

ELECTRIC SERVICE MANUFACTURING COMPANY • 17th & CAMBRIA STS., PHILA. 32, PA.

CRYSTAL VALVE
LIGHTNING ARRESTERS

. . through Okonite-Callender Research

OKOSHEATH

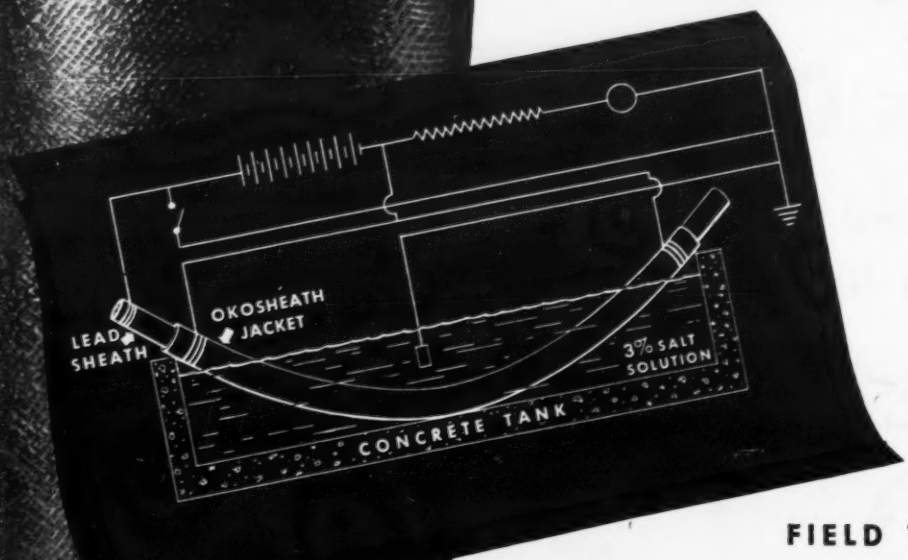


The record shows that failure of the lead sheath is the greatest single cause of failures in impregnated paper insulated power cables. Furthermore, corrosion causes most of the troubles with lead sheaths.

To overcome this, Okonite-Callender, in 1933, made the first paper insulated power cable with an Okosheath Protective Covering over the lead. The type of compound selected was based on Okonite's long experience in producing non-metallic underground cables for direct burial under the worst possible corrosion conditions. Since then, extended laboratory tests and broad service experience have proved the quality of Okosheath Protective Covering.

Okosheath has been used on all types of cables, even for 132,000-volt oil-filled transmission cables, to protect them from known local corrosive conditions.

For specific information regarding your lead sheathed cable installations, get together with an Okonite-Callender engineer. He will be glad to help you.



SEVERE SIX YEAR TANK TEST PROVES CORROSION RESISTANCE OF OKOSHEATH COVERING

Section of solid type impregnated paper cable protected with Okosheath in 3% salt solution in concrete test tank. Voltage continuously impressed between the sheath and the solution made the lead sheath positive. After six years in the tank, the Okosheath Covering showed a resistance in excess of 250,000 ohms. And upon removal of the Okosheath Covering, no sign of corrosion was found on the lead sheath and the Okosheath itself was unimpaired.

FIELD TEST

Here is how Okosheath Protective Coverings have been protecting cables in the field:

A 150-foot length of Okosheath covered cable was installed in a standard duct system. This test length had been periodically removed from the ducts and reinstalled after careful examination and tests. Today, after more than ten years, the Okosheath Protective Covering is still in excellent condition although the outer fabric tapes show some deterioration because of the excessive pulling in and out of the duct.

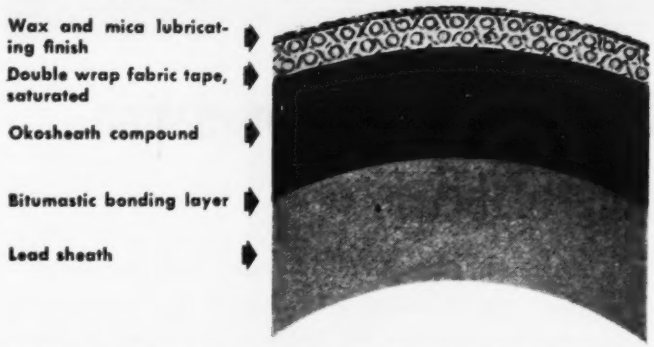
OKONITE-CALLENDER

PROTECTIVE COVERING FOR LEAD SHEATHS

3 TYPES OF *PERMANENT PROTECTION* FOR LEAD SHEATHS PROVIDED BY OKOSHEATH

1. Okosheath Protective Covering is impervious to all corrosive agents likely to be encountered in underground ducts and thus effectively stops them from attacking the lead.
2. Possesses good electrical insulating properties thus eliminating electrical corrosion such as is caused by electrolysis and sheath currents. Insulation resistance measurements between lead sheath and ground after several years in underground ducts, where corrosive conditions were known to be severe, have proved the permanent electrical insulating quality of the Okosheath Protective Covering. This makes it particularly desirable for use on large size single conductor cables which are likely to have heavy sheath currents.
3. Prevents mechanical injuries to the lead sheath such as scratches, abrasions and dents that are impossible to avoid completely when handling and pulling ordinary lead covered cables. These are the points in the lead sheath at which both corrosion and fatigue become concentrated.

Cross-section view of Okosheath Protective Covering



The Okosheath Protective Covering includes a coating of asphaltum on the outer surface of the lead sheath. Next is a layer of Okosheath compound which is applied uniformly over the cable. Overall is a layer of heavy, rubber compound filled duck tape. The cable, with tape layers as described, is passed through a bath of hot saturating compound which causes the Okosheath to fuse and vulcanize into a continuous sheath or jacket. A final coating of powdered mica facilitates pulling in of the cable with Okosheath Protective Covering.

Natural rubber was generally used in the Okosheath compound until the shortage in our rubber supply occurred. Now Buna S synthetic rubber or Okoprene (made with neoprene) are used in the Okosheath compound. Tests indicate that results with Buna S or Okoprene are comparable with those of natural rubber. Okoprene is preferable because of its superior oil resistance and nonflammable quality while costing no more. The Okonite-Callender Cable Company, Inc. Executive Offices: Passaic, New Jersey.

Okosheath Quick Quiz

Q. What about cost?

A. Okosheath Covering is relatively cheap corrosion insurance. For a standard 3-conductor, 350,000 CM, 15,000-volt paper-insulated lead covered cable, the Okosheath covering adds about 20% to the cost.

Q. Is this expensive?

A. Not when you consider that it is unnecessary to protect the entire line in this manner. Okosheath covering need only be applied in sections where corrosion is known to exist. Compare it with the cost of a single lead sheath failure which involves the following items: locating trouble, withdrawing the defective faulty length, supplying a new cable, pulling in the new length and splicing it. This does not even consider revenue loss due to service interruptions.

Q. How much is the cable diameter increased?

A. Okosheath jackets are about ⅛" thick and add approximately 0.250" to the cable diameter.

Q. Are special lubricants necessary for pulling?

A. No. The wax and mica finish on Okosheath make pulling easier. Soap flakes can be used as a lubricant if desired.

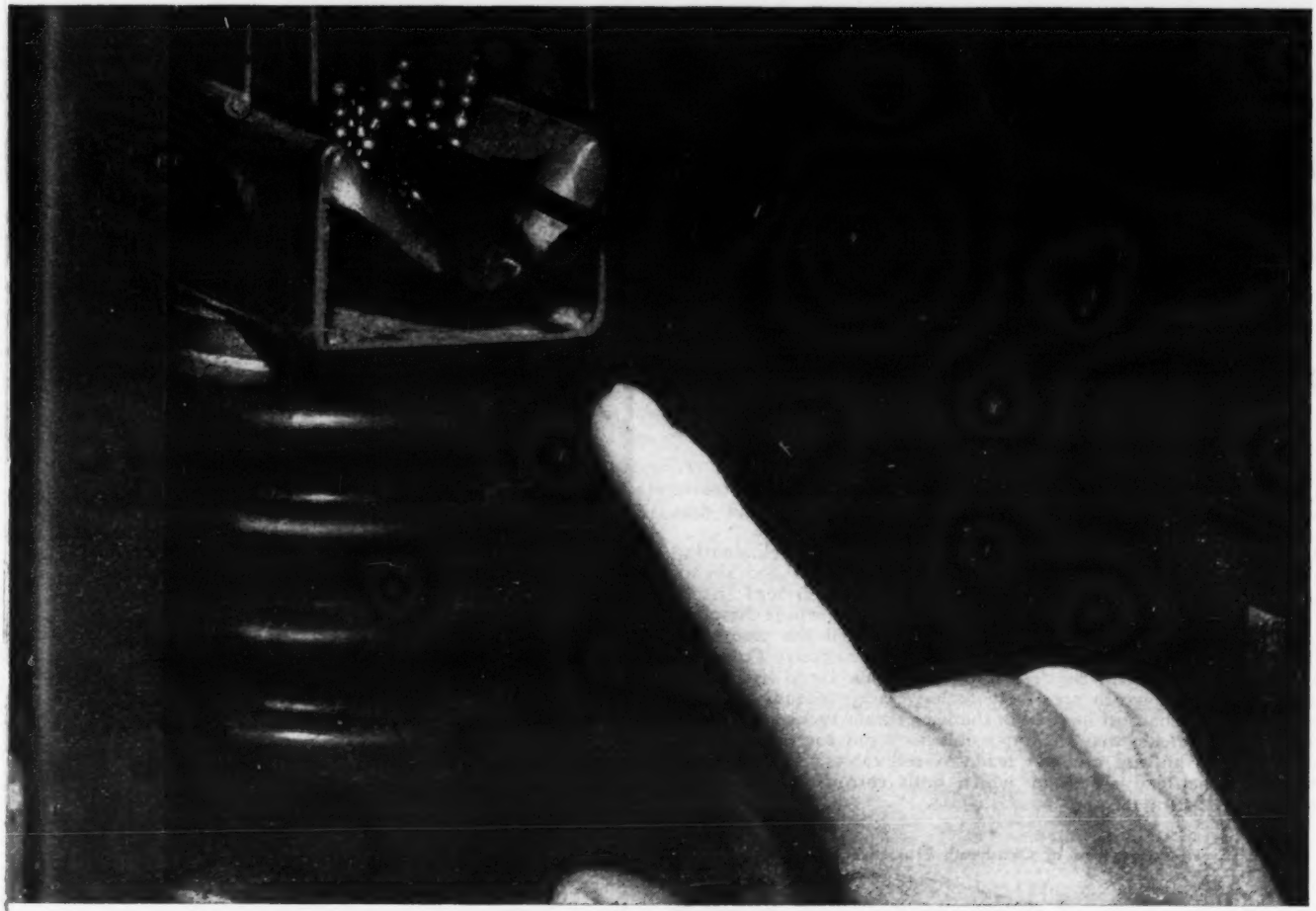
Q. Is special handling required at joints?

A. Usually not, unless the cable is completely submerged or electrolytic corrosion is anticipated or cathodic protective devices are used.

Q. Is the current-carrying capacity of the cable affected by the Okosheath Covering?

A. No, because of the increase in surface area.

paper insulated power cables



High dielectric strength of Geon electrical insulation proved by a string of beads

AS GEON insulated wire leaves the extruder and the cooling bath in today's modern wire factories it asses through a group of little metal beads like the ones n the picture. In this test the beads are charged with high oltages well beyond the requirements of the insulation eing applied to the wire. Thus high dielectric strength hich permits *thin-wall* insulation—and its attendant ains in all phases of wiring efficiency—is assured.

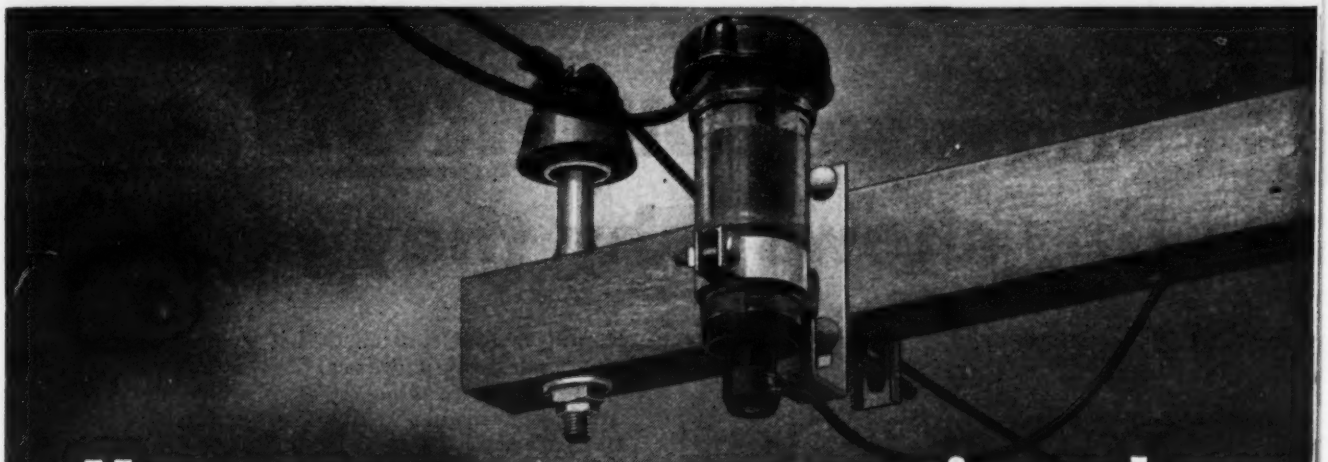
Additional tests demonstrate and safeguard this and ther important electrical properties of the polyvinyl aterial that has served so well as self-extinguishing in- ulation for navy cable of all kinds, abrasion-resistant nsulation for assault wire and in many other war applica- ons. Soon GEON insulation will go into thousands of ew homes and factories that will be built when materials re released for this purpose. For its electrical properties ill mean thinner insulation, which will permit more onductors per conduit. The slick surface will mean easier nstallation; time and money saved. Its aging qualities will practically eliminate maintenance and replacement.

Further, GEON electrical insulation has outstanding resistance to chemicals, air and ozone, oils and greases, aging and light. And it can easily be colored in the 14 standard NEMA colors. These properties may be had in a wide variety of combinations to meet specific service conditions.

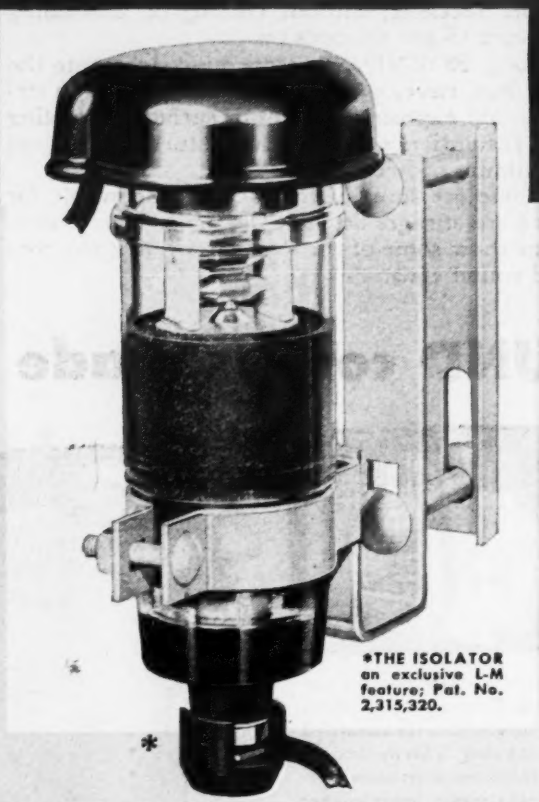
Right now all the GEONS are subject to allocation by the War Production Board. Limited quantities can be had for experiment and our development staff and laboratory facilities are available to help you work out any special problems and applications. For more information write department CC-1, Chemical Division, The B. F. Goodrich Company, 324 Rose Building, Cleveland 15, Ohio.

CHEMICAL DIVISION
THE B. F. GOODRICH COMPANY
324 ROSE BUILDING • CLEVELAND 15, OHIO

Geon
Polyvinyl Materials



How your new-construction plans can benefit by this advanced research



*THE ISOLATOR an exclusive L-M feature; Pat. No. 2,315,320.

It's the way they're made that results in better protection . . . less replacement . . . lower arrester costs.

1. Ladder gap of solid 7/16" brass bar accurately machined, and spaced in isolantite supports.
2. Characteristic element *molded* into glass housing (porcelain also used temporarily as a wartime measure).
3. Completely moisture-proofed: 2 main seals, 4 auxiliary seals; assure permanent protection.

STANDARDS: All L-M Lightning Arresters meet new NEMA standards; maintain uniform characteristics throughout life of arrester.

SIZES: Made in 6 sizes from 1 to 15 Kva. ratings.

THE economical construction and operation of new lines will be achieved more easily when your planning takes advantage of Line Material's research, and L-M developments in materials and products.

Years ago, Line Material Company set up a research program to develop methods of satisfying the industry's need for products exceeding the standards then considered attainable.

One example of the resulting constant improvement is Line Material Lightning Arresters. Again and again, L-M has pioneered in improvements which later have become the accepted standard. Several types have been developed, to satisfy various operating requirements.

Today, L-M Lightning Arresters give greater protection, and greater value, than any this company has ever offered. It will pay you to standardize on them for your present and your future construction. The L-M field engineer's knowledge and experience are at your service, to help you select the types that will best fit your requirements. Call or write the nearest L-M branch office. Line Material Company, Milwaukee 1, Wisconsin.

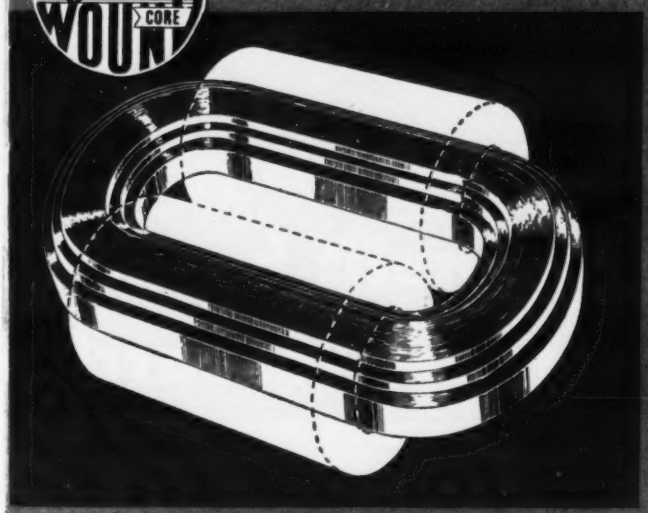
LM

LINE MATERIAL
LIGHTNING ARRESTERS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers • Fuse Cutouts and Fuse Links • Lightning Arresters Oil Switches • Pole Line Hardware • Line Construction Specialties • Underground Equipment • Fibre Conduit • Street Lighting Equipment

How we build ROUND- shows why they provide

ROUND WOUND COILS CORE



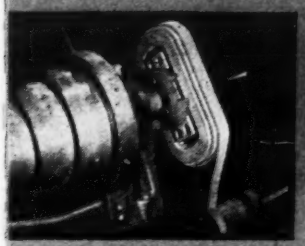
Round-Wound construction is surprisingly simple, remarkably ingenious. But, more important is the degree to which it attains the characteristics so desirable in distribution transformers. Here are some of the reasons:

Core is WOUND, under tension in an ellipse, *with* the grain of the silicon-steel strip; without air gaps to disturb the flux; without wasteful corner sections; without cutting or unwinding the core to get the coils on.

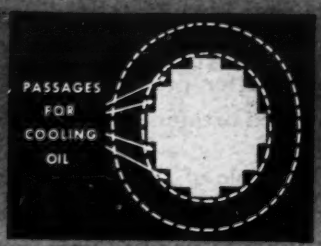
Long, ROUND coils are wound right onto the core legs, enveloping a maximum of the iron circuit, and exposing maximum surface to cooling oil. Insulation is generous, undisturbed; provides maximum protection.

These are some of the factors responsible for the 5 advantages listed at the right. The illustrations show some of the steps in winding the core and round coils.

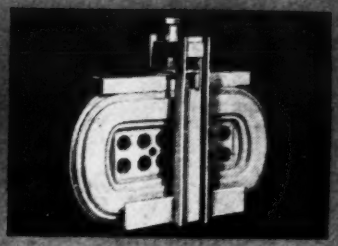
How the elliptical WOUND core is made



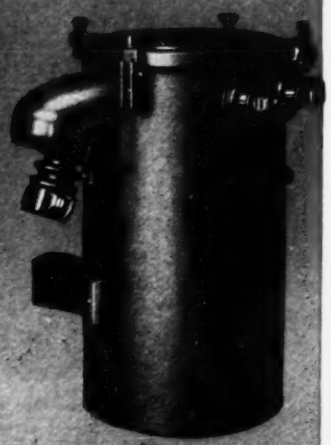
ore is wound in elliptical ape, closely approaching the rfect magnetic flux move- ent—"100% downstream". licon-steel strip is *wound nder tension* and clamped. esult—*no air gaps;* exciting rrent as much as 50% lower.



Successive varying widths of steel strip are joined, and wound so that core cross section is *cruciform*, approximating the round. This shape, electrically ideal, provides channels between core and coil for free circulation of cooling oil.



Wound core, *clamped for annealing*. Core is not disturbed, cut, or unwound or disassembled after annealing. This method assures stable characteristics; freedom from stresses; lower leakage flux; lower core loss.



L-M ROUND-WOUND TRANSFORMERS are available in 1½ to 25 Kva, 2400 to 7620 volts; and meet latest EEI and NEMA standards.

Get This Bulletin FREE

Ask the L-M field engineer or the nearest L-M office, for a copy of Bulletin RW-421. Gives a lot more information than we can get into this advertisement. Line Material Company, Milwaukee 1, Wis.

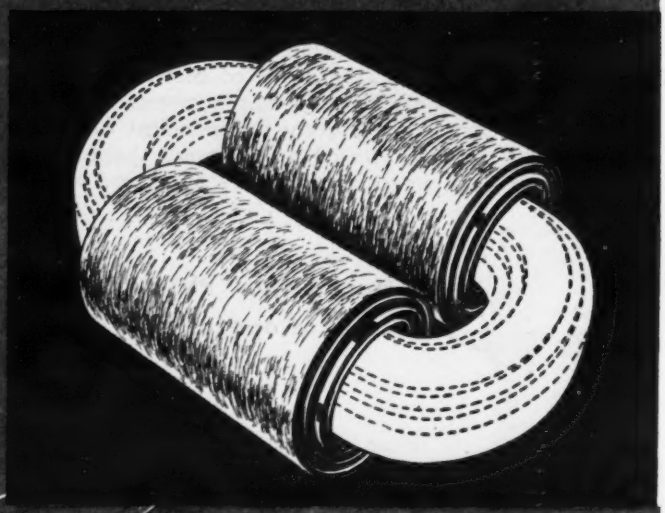
LM

LINE MATERIAL
TRANSFORMERS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers • Fuse Cutouts and Fuse Links • Lightning Arresters Oil Switches • Pole Line Hardware • Line Construction Specialties • Underground Equipment • Fibre Conduit • Street Lighting Equipment

WOUND transformers
these advantages:

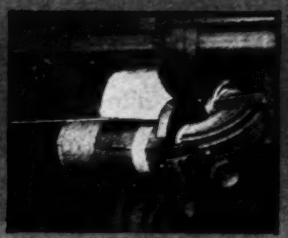
1. Improved regulation at *all* power factors
2. Better ratio of losses
3. Uniformly low exciting current
4. Uniformly high impulse strength
5. High short-time overload capacity



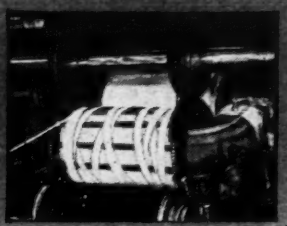
How we get the ROUND coils onto core

Geared split flanges are placed onto the taped core leg. Core leg acts as shaft upon which these flanges are rotated by gears on the winding machine.

First an insulating paper winding form is wound on; this becomes part of the finished coil. (Geared flanges are removed after coil winding has been completed.)



Coils are wound over this form, right onto core. The process assures even tension; no air spaces between layers; generous, undisturbed insulation.



Oil duct spacers are wound into the coils during the process. These provide extra cooling for coils, and assure freedom from any possible hot spots.

Here are the results of ROUND-WOUND construction:

Ideal core shape, without air gaps; and long, evenly-wound coils with no air spaces between layers, take maximum advantage of the magnetic field created and permit fewer turns in coils without sacrificing low exciting current; generous, undisturbed insulation; exceptional cooling oil passages and cooling surfaces; result in: reduced leakage flux; low reactance; improved regulation at all power factors; uniformly high impulse strength; greater protection against lightning hazards; and greater capacity for short-time overloads. These are some of the reasons why it pays to standardize on L-M ROUND-WOUND distribution transformers, now, and for your new construction.

LM

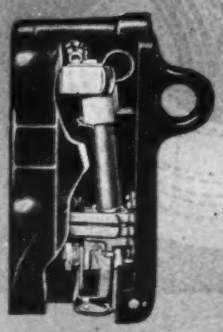
LINE MATERIAL
TRANSFORMERS

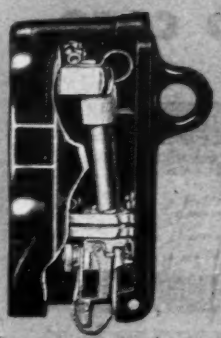
L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers • Fuse Cutouts and Fuse Links • Lightning Arresters • Oil Switches • Pole Line Hardware • Line Construction Specialties • Underground Equipment • Fibre Conduit • Street Lighting Equipment

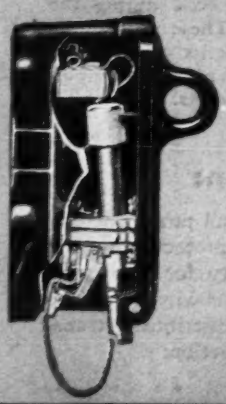
How they operate shows why L-M "PVD" DISCONNECTING INDICATING FUSE CUTOUTS

Give . . . instant action . . . fast re-fusing . . . long, dependable service

The design and construction of "PVD" Fuse Cutouts assures quality beyond and above that of the usual fuse cutout. Link flip-out device assures instant separation of blown link. Arc clears in the tube—no arcing between contacts. Operation is completely independent of door, which remains closed at all times, protecting parts from weather, dirt, corrosion; and assuring long, dependable operation. The indicating feature saves hunting and, with the fast re-fusing for which "PVD" Cutouts are noted, helps shorten interruptions of service. Get the details; ask your L-M field engineer to tell you about "PVD'S"; call or write the nearest L-M office, or Line Material Company, Milwaukee 1, Wisconsin.







Here's the "PVD" cycle of operation

1

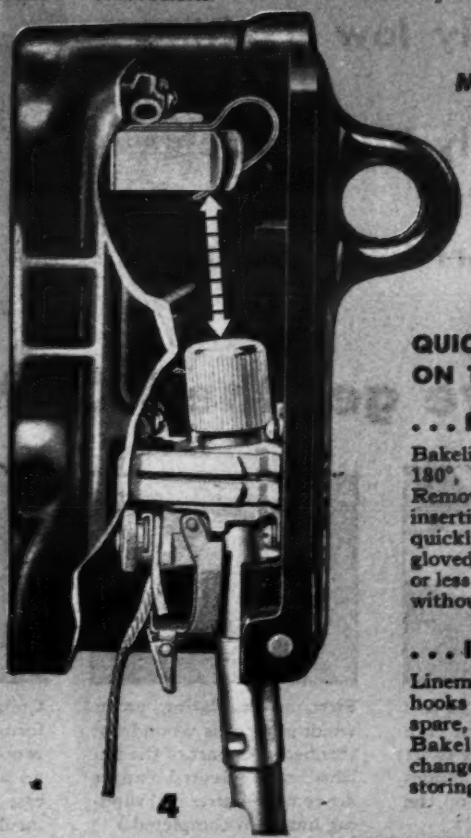
Fused position. Door always closed; parts always protected from weather, dirt, corrosion. *Operation is independent of the door.*

2

As fuse blows, link flip-out device assures instant separation of blown link parts before latching lever can release tube to indicating position.

3

Arc clears inside tube before contacts separate. As latching lever releases tube, upper contact follows tube part way; gives extra time to clear arc; assures positive drop.



4

Large air gap between contacts prevents arcing; assures long service. Cartridge drops to indicating position—easily seen from ground. This signal saves time, saves hunting.

MADE IN 4 SIZES

5000 V. delta, 50 amp.
7500/12500 V. Gr. Y., 50 amp.
5000 V. delta, 100 amp.
7500/12500 V. Gr. Y., 100 amp.

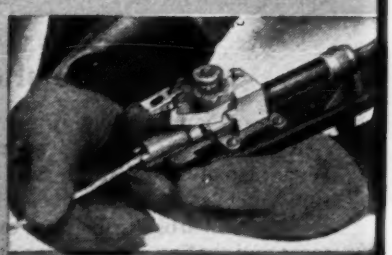
QUICKLY RE-FUSED, ON THE POLE!

. . . IN ONE MINUTE

Bakelite door swings open 180°, then unhooks easily. Removing blown link and inserting new one is done quickly, easily, even with gloved hands. In 60 seconds or less the whole job is done, without any tools.

. . . IN SIX SECONDS

Lineman just opens and unhooks door, and slams on a spare, fused "PVD" door. Bakelite doors are interchangeable, save time in restoring service.

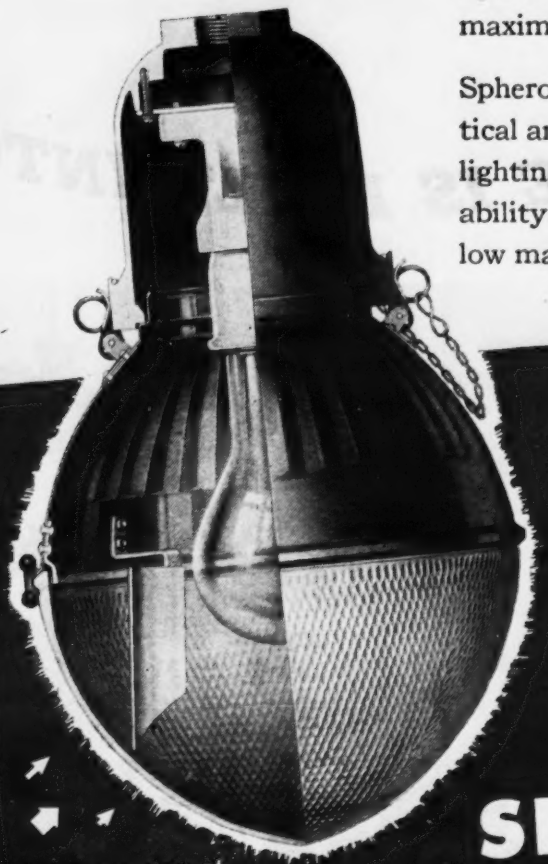


LINE MATERIAL
FUSE CUTOUTS & FUSE LINKS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers • Fuse Cutouts and Fuse Links • Lightning Arresters • Oil Switches • Pole Line Hardware • Line Construction Specialties • Underground Equipment • Fibre Conduit • Street Lighting Equipment

YOU can get the kind of light you want, *where* you want it, with L-M Spherolite. From a concealed source, the Spherolite distributes the light over a wide area, producing maximum visibility with a minimum of glare.

Spherolite has many desirable features that make it practical and economical—a sound investment for every outdoor lighting job. Its permanence, adaptability, interchangeability, tight seals against moisture and dirt, and resulting low maintenance make Spherolite exceptionally economical.



Cut-away view of Spherolite showing scientifically designed fluted reflector, which puts all the light to work.

When you plan street lighting plan . . . SPHEROLITE-ing!

Line Material is one of the oldest and largest manufacturers of street lighting equipment—with a complete line of standards, brackets, luminaires, transformers, control and protective equipment. Its field engineers are experienced; the wide variety of L-M equipment enables them to give you sound advice and valuable help in selecting the proper equipment for *your* lighting problem.

Don't fail to discuss your plans with one of these capable counselors. Call or write the nearest L-M office, or Line Material Company, Milwaukee 1, Wisconsin.

LINE MATERIAL

STREET LIGHTING EQUIPMENT

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers · Fuse Cutouts and Fuse Links · Lightning Arresters · Oil Switches · Pole Line Hardware · Line Construction Specialties · Underground Equipment · Fibre Conduit · Street Lighting Equipment

HOW EXCELLENCE IS BUILT INTO

BUSY HANDS *There can be no letdown in any one of the critical operations required in the production of Sangamo MICA CAPACITORS That is why every Sangamo operator in each department is fully trained in her particular duty until she becomes thoroughly capable in doing her task. These operators know the importance of accuracy and maintain faithfully the Sangamo standard of excellence.*

SANGAMO ELECTRIC

ESTABLISHED 1898 • • • MICA CAPACITORS • •

Sangamo MICA CAPACITORS

Because of the precise and accurate operations involved in the manufacture of mica capacitors, too much emphasis can not be placed upon the importance of modern equipment and adequate working facilities. The facilities used by Sangamo for gauging mica are shown in the attached picture. Other departments, utilizing equally accurate, modern, and efficient methods, for MICA SPLITTING, MICA PUNCHING, INSPECTION, and STACKING, are all vital factors in maintaining Sangamo excellence.

Mica Gauging

The preparation of mica to be used as the dielectric in mica capacitor requires many steps. Splitting the lamin tions from the mica block is the first step, but it is on the beginning in a long and carefully controlled seri of operations in the final preparation of the mica. As th electrical capacitance of a mica capacitor depends upo the dielectric constant of the mica, its thickness, and th active area of the electrodes used in the unit, these facto must be accurately controlled. In some cases sever thousand or more individual mica films are used in th construction of a capacitor and the dielectric failure any one of these pieces would result in the destruction the entire unit. Consequently, it is readily apparent th extreme care in selecting and gauging of the individu mica laminations is of extreme importance. The diele tric constant of mica is determined by precise electric measurements, but usually this constant is fairly unifor for any group or batch of mica of equal quality whe obtained from a single source or mine.

While proficient splitting operators can split mica that approximately 80% or more of their productio will come within limits of one-half thousandth of a inch in thickness, this is not sufficiently accurate to a complish the results desired in obtaining uniformity characteristics. Consequently, it is necessary to gauge eac mica lamination on special beam gauges, as shown in th accompanying picture. Here, trained operators sele mica to thickness limits of one-fourth of a thousandth an inch or less. This gauged mica is separated into grou according to the thickness of the lamination, and eac group is then ready to be punched to the special size an shape required for the particular capacitor in which it to be used.

COMPANY SPRINGFIELD ILLINOIS

• • • WATT HOUR METERS • • • TIME SWITCHES • • •

-279-T

Victory Will Mean

NEW JOBS *for* STEAM

Steam will blow the whistles when the big news comes. But, in heralding the great day, steam will have done far more than sound the signal for rejoicing.

Beyond steam's part in victory . . . beyond its record of powering ships, trains, war plants, there will be thousands of stories of men . . . *engineers* . . . men with trigger minds instead of trigger fingers . . . who tackled power plant problems with keen resourcefulness so that power for war needs would never be "too little or too late". With the end of hostilities will come new Victory jobs for steam . . . new problems . . . keener competition that will put emphasis on operating costs.

With today's accelerated experience yielding more complete answers to such problems as behavior of metals at high temperatures, action of fuels in slag-tap and dry-ash furnaces, circulation in high-capacity high-pressure boilers, separation of steam from water in boiler steam drums, and other related problems, the boilers of tomorrow will be even better able to serve industry.

Building boiler units complete with all essential components . . . controlling both the design and the application of the equipment fabricated . . . these, plus extensive facilities, give us at B&W a background that's unique. As a result our engineers have at their disposal an array of boilers from which to meet any combination of conditions of capacity, pressure, temperature, feedwater, fuel, and space. Now is a good time to consult with us regarding your steam plant requirements for the future.

6419

Army-Navy "E" flags have been awarded to five B&W plants, and also the Maritime Commission Award flags to the Barberton, Ohio, Plant.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N. Y.

End-weld Studs Automatically!

Nelson studs are end-welded to metal. No drilling holes... no welding bolts.

Used by more than 500 shipbuilding and industrial plants.

Complete fusion between stud and plate in less than ½ second!

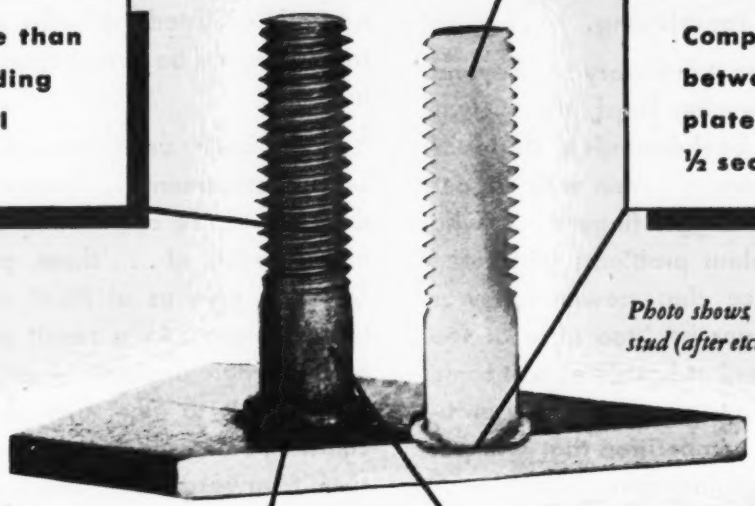


Photo shows cutaway view of stud (after etching with Nital).

Operators can weld 500 to 1000 studs a shift. Completely automatic operation.

Many diameters, lengths, and types, for securing parts of all kinds.

The Model "H" Arc Stud Welder

For complete details and catalog, write:

NELSON SPECIALTY WELDING EQUIPMENT CORPORATION

Dept. EW, 440 Peralta Ave., San Leandro, Calif.

Eastern Representative: Camden Stud Welding Corp. Dept. 122, 1416 So. Sixth St., Camden, N. J.

NELSON STUD WELDERS & STUDS

CONSERVE VITAL MATERIALS WITH

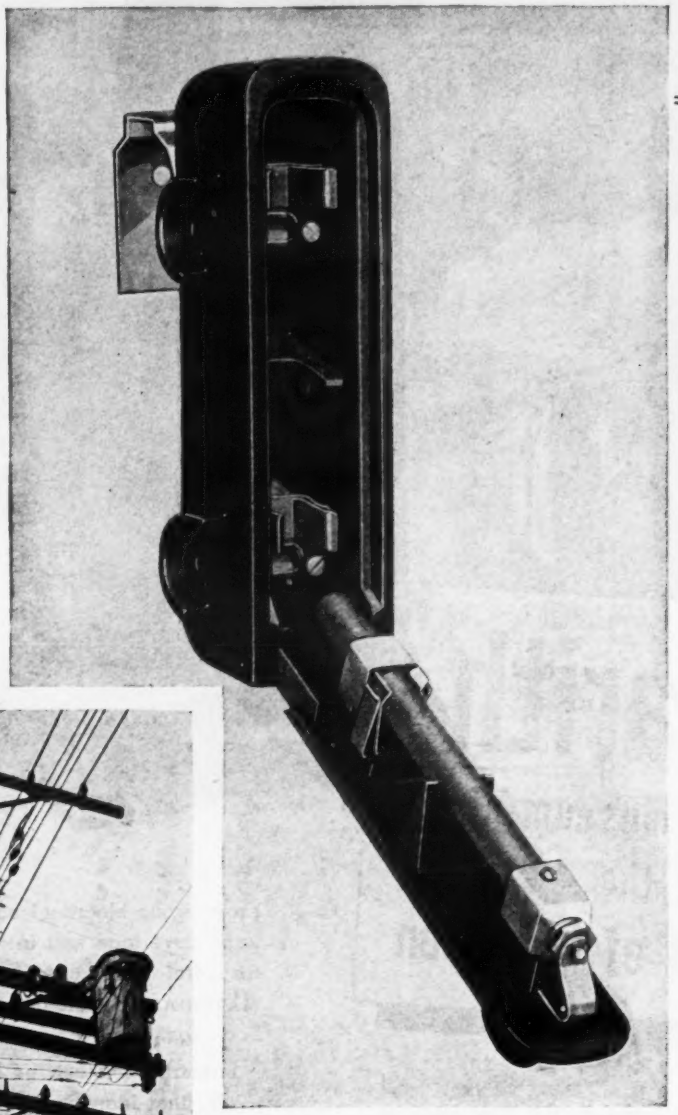
NON-INDICATING, PORCELAIN-HOUSED MATTHEWS CUTOUTS

RATINGS

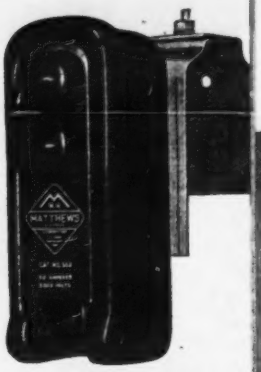
50 and 100 Amperes
5 and 7½/12½
Kv Grd. Y

INTERRUPTING CAPACITIES

1200 and 3000
Amperes

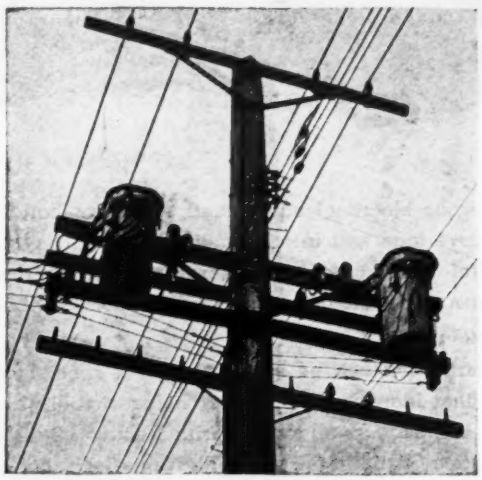


Catalogs 950 and 956
(Interior detail same in all sizes)



Catalog 650

Catalog 850



Shows two single phase 4400 volt installations of Catalog 650 Matthews Cutouts.

Simple, sturdy design conserves vital war materials and man power by eliminating moving parts but without sacrificing electrical and mechanical efficiency.

For complete details
Write for Bulletin 103

WHY THEY ARE LIKED

Simple —Rugged — No Moving Parts — Heavy Everdur Set Screws — All Current Carrying Parts Over 85% Copper Content —Time-seasoned Bakelite Covered Fibre Fuseholder Tubes Which Won't Warp — High Flashover Values — High Interrupting Capacity — Lowest Time-cost — Over 400,000 In Use. No essential changes in design in over fifteen years, but many refinements have been made. Price is lower than for indicating type.

W. N. MATTHEWS CORPORATION

SAINT LOUIS, U. S. A.

ENGINEERS and MANUFACTURERS SINCE 1899

Lumarith*

has made a museum-piece of the Black Hand of Corrosion

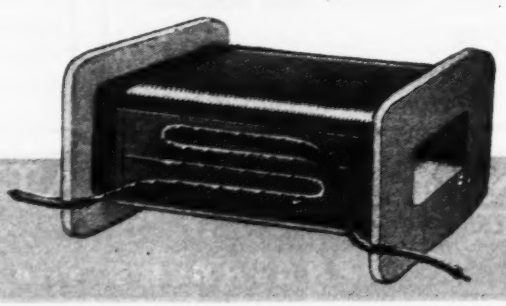
HE BLACK HAND of corrosion feeds on the free acids released by insulating materials that are in contact with current-carrying copper wire and moisture. In delicate circuits, can cause the wire to break—in any circuit it can create ps in the insulation, shorts across the line and consequently interfere with operation of equipment.

Now, Lumarith (cellulose acetate base) has made a museum-piece of the black hand. Lumarith is resistant to electrolytic action. It does not combine with moisture and current, give corrosion a breeding ground. It is unique among electric materials in this respect.

Check on the various forms by which Lumarith can improve your electrical equipment: FOILS for coil linings, coverings and interlayer insulation . . . FILMS for spiral-wound tubes (square or round) . . . MOLDING MATERIALS for molded parts—coils, spools, bobbins, housings, bases, plugs . . .

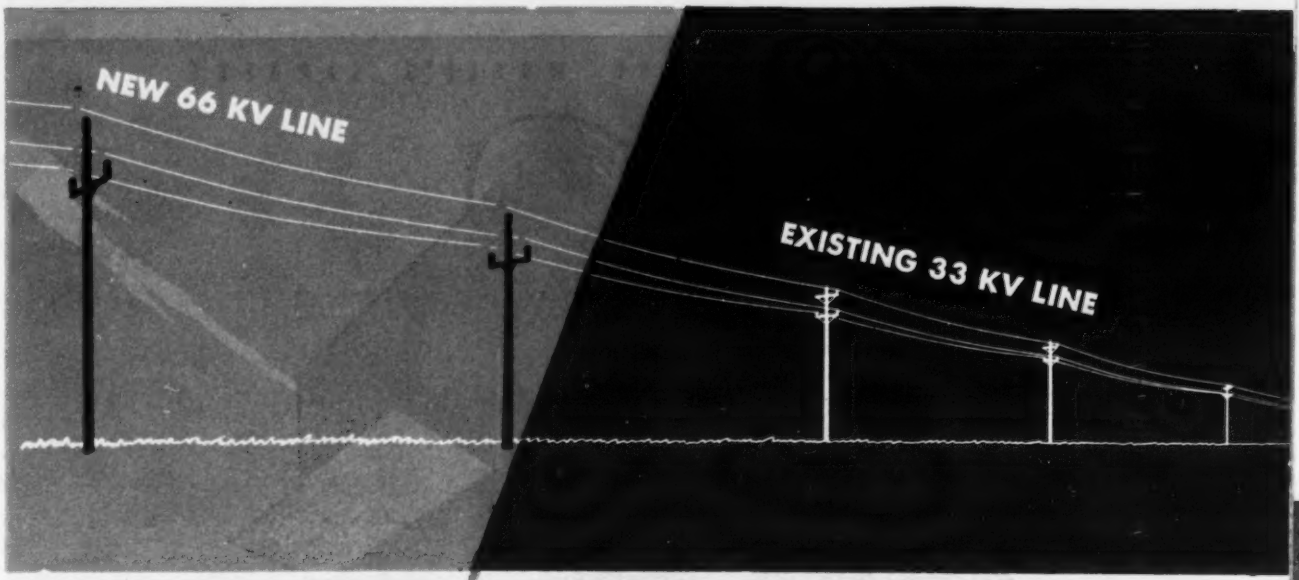
Lumarith foil can be supplied with a special mat finish (A-78) that increases elongation, helps visibility and prevents wire slippage. Send for Lumarith Electrical Booklet. Celanese Plastics Corporation, *The First Name in Plastics*, a division of Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y. ***Celanese Yarns and Fabrics offer the same dielectric and corrosion resistant qualities as Lumarith Plastics. For data, address Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y.***

* Reg. U. S. Pat. Off.



LUMARITH* A CELANESE* PLASTIC

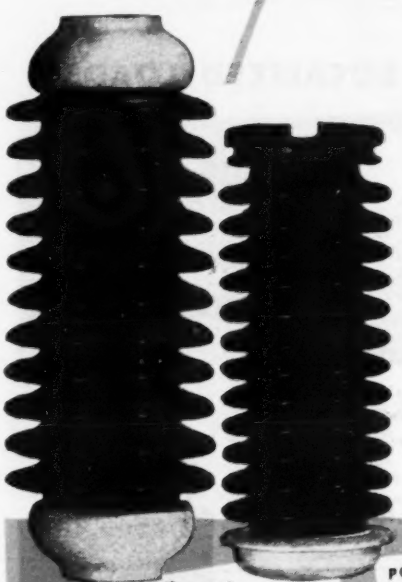
Films . . Foils . . Sheets . . Rods . . Tubes . . Molding Materials



LINE CONVERSION WITH LAPP LINE POSTS

is the fastest way to fortify your system.... and uses least materials

New or increased load demands frequently can most efficien be handled by conversion of existing lines to higher volta For this job, Lapp Line Posts are particularly suited. Usi present sound poles and conductors, conversion to higl voltages can be accomplished with no more than new cro arms and Lapp Line Posts. Nor need such construction considered as an emergency temporary expedient. Such a li approaches the current ideal for a new line; and your La Posts can be expected to give trouble-free service for a long period of years than you ever got from conventional insulato



LAPP LINE POST and STATION POSTS on your system offer . .

POWER ARCOVER. *Flashover and leakage distances are not appreciably lowered by damage —even loss of several petticoats.*

NO PUNCTURE. *Puncture path in Lapp Post design is as great as flashover path. Insulator will flash over rather than puncture.*

NO CRACKING. *One piece post body, not subject to bursting from tension strains created by thermal changes in nested parts.*

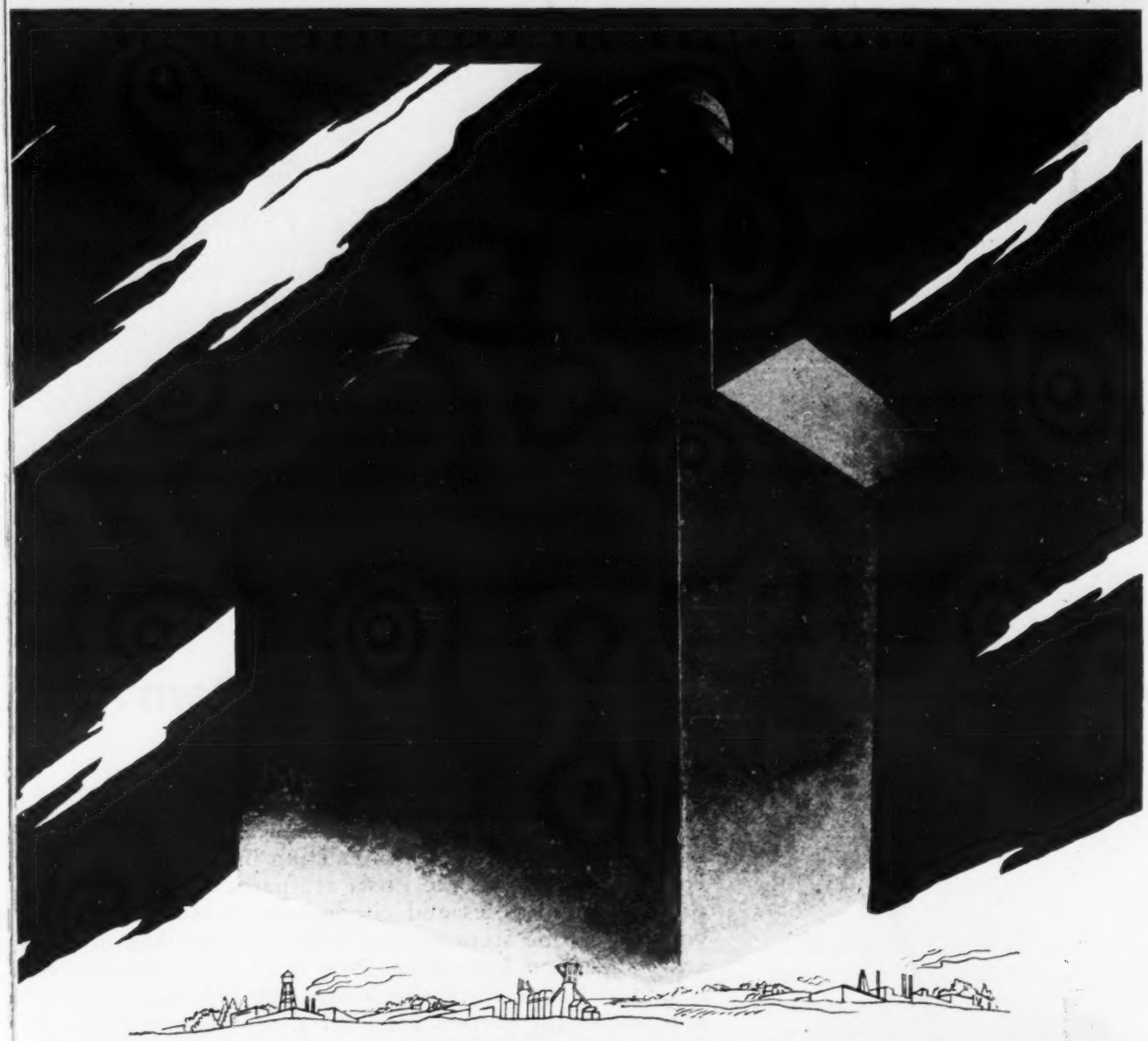
RADIO INTERFERENCE. *By virtue of design factors alone, radio interference is permanently prevented at rated neutral voltage.*

NO CLEANING. *Fog-type design preserves uniform leakage path, prevents leakage flashover, makes the unit "self-cleaning."*

MECHANICAL RUGGEDNESS *Stones or bullets deflect off, c rupture petticoats, leaving po body intact and insulator secur*

Lapp

LAPP INSULATOR COMPANY, INC., LE ROY, N. Y.



SATISFYING KILOVAR REQUIREMENTS OF LARGE LOCALIZED LOADS

with C-D capacitors in banks

In C-D Capacitor banks, many utilities have found the best answer to present demands for large blocks of reactive. Flexible, efficient and quickly installed, these C-D Capacitor banks will supply the required Kva with minimum delay and use of critical materials. Our engineers will be glad to discuss the advantages of C-D capacitor banks as applied to your specific problems. Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

ADVANTAGES OF C-D CAPACITORS

EXTREME FLEXIBILITY — Circuit arrangement permits the switching of corrective capacity to conform to load.

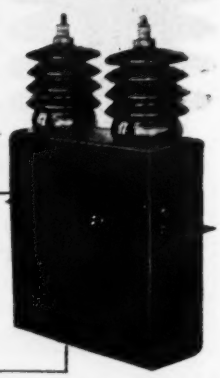
EXTREME MOBILITY — C-D Capacitors can be quickly removed to other locations to relieve sudden low power factor.

QUICKLY INSTALLED—Can be installed and put into operation in a fraction of the time required for other types of corrective equipment. Use less critical materials.

MAXIMUM EFFECTIVENESS — Capacitors are the most efficient reactive source and require a minimum of maintenance and attention.

A C-D CAPACITOR BANK INSTALLATION

Part of a large bank of 15KVA, 7960 volt Individual Outdoor Capacitors installed on 13,800 volt system at a Light Metals Plant.



15 KVA *7960 Volt*
1 phase *60 Cycle*
Individual Outdoor Capacitor

CORNELL-DUBILIER CAPACITORS

FOR POWER FACTOR IMPROVEMENT
CARRIER CURRENT COUPLING
SURGE PROTECTION

1910 – 1944

SIX POUNDS SAVED ON AIRCRAFT MAGNETO WITH AID OF *Melmac Plastic* PARTS

Through the use of new materials and new design, the Edison-Splitdorf division of Thomas A. Edison, Inc., found it possible to limit the weight of the new Edison SF9LD-I 9-cylinder aircraft magneto to approximately nine pounds—*more than six pounds lighter* than any other of the same capacity. At the same time, electrical output, mechanical strength, and all-around efficiency were maintained.

Mineral-filled MELMAC*, heat and arc resistant plastic developed by Cyanam is used for magneto distributor head two-pole rotor. It proved superior to materials in hardness, it offer advantage of light weight and its electric strength and resistance t tracking add to the life and effi of the magneto.

These same physical and elect properties of MELMAC offer you a wi riety of possibilities for improvement esign and operating efficiency in many es of electrical equipment. Further inf tion on the use of new MELMAC plas will be sent on request.

*Reg. U. S. Pat. Off.

★

MELMAC distributor head and rotor ope efficiently under the most severe service con tions in the new Edison SF9LD-I 9-cylinde aircraft magneto, which is installed as standard equipment in Eastern Aircraft's "Wildcat" Fighters, Douglas "Dauntless" Bombers, Curtis Scout and the Grumman and Columbia amphibians.

Cyanamid Plastics

Beetle · Melmac · Melurac
Laminac · Urac

AMERICAN CYANAMID COMPANY
PLASTICS DIVISION
30 ROCKEFELLER PLAZA · NEW YORK 20, N. Y.

Highlights of Anaconda messages to the public

re: POSTWAR ELECTRICAL POSSIBILITIES

TIME

..."America's electrical future is limitless... with victory, expanded use of electric energy will affect everyone—industrialist, dealer, housewife—employment, prosperity, living."

BUSINESS WEEK

..."but this fact is all important: when you plan your electrical future, start with *wiring. Adequate* wiring will be essential to full utilization of tomorrow's electrical possibilities . . . and that applies to municipality or factory, business or home . . ."

NEWSWEEK

..."by all means, bring the power engineer from your local utility and your electrical contractor into your *advance* planning. *Unwired* planning will cost you a lot more than *planned* wiring!"

Anaconda Wire & Cable Company is devoting its current advertising to spreading public knowledge and appreciation of what the electrical industry means to the country and to postwar prosperity.

Obviously, adequate wiring will be essential. The wider the recognition of this, the better business for everyone... utility, contractor, wholesaler, manufacturer.

And now is the time to lay the foundation for tomorrow's electrical needs. More and better wiring should be a part of every postwar plan.

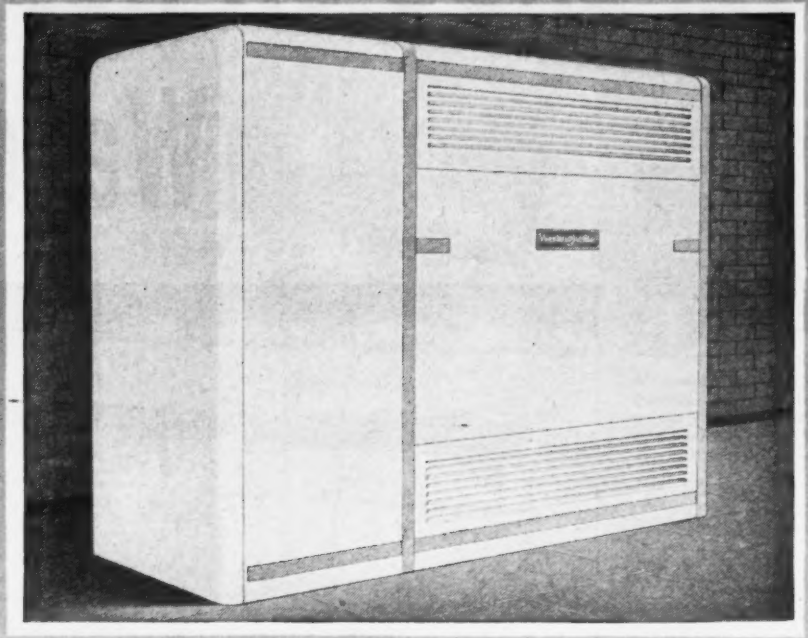
44220

ANACONDA

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4 . . . Sales Offices in Principal Cities

Electrical Wires and Cables of Copper are the Life Lines of our Nation



Westinghouse ASL Transformers are available in 150 to 4,000 kva ratings, 15,000 volts and below

1,000,000 kva says OK!

THE ASL TRANSFORMER COMBINES:

1. **GREATER SAFETY**—No cooling liquids—no fire or explosion hazards. No vault is required.

2. **GREATER RELIABILITY**—Winding temperature is not a critical factor in loading . . . heavy overloads carried safely.

3. **LOWER INSTALLATION COST**—Transformers can be placed indoors near load centers—no long secondary runs of heavy copper—no catch basins or drains are required. Lighter weight and easier to handle in the larger ratings.

4. **LOWER MAINTENANCE COST**—No periodic liquid reconditioning—no gasketed joints to maintain, no valves to leak. Maintenance is negligible, even in dust-laden atmospheres.

5. **GREATER SPACE ECONOMY**—In large ratings ⅓ or more of the space that is required by liquid-filled transformers may be saved.

6. **LOWER COMBINED COST**—In major substation design, both air-cooled transformer and metal-clad switchgear with air breakers can be installed INDOORS as a completely metal-enclosed, multiple unit substation . . . saving cable cost, space and installation work.

Dust . . . dirt . . . fumes . . . heat . . . dampness . . . condensation . . . none of these enemies of electrical equipment found in metal-working shops, coal mines or paper mills, in both temperate and tropical zones, have been able to affect the operation of Westinghouse Type ASL Air-Cooled Transformers.

Since their introduction in 1936, Type ASL Transformers have received extensive field testing—particularly by emergency war loads which have compressed decades of normal operation within a few years. Over 2,000 installations, totaling more than 1,000,000 kva, are proof today that the ASL Air-Cooled Transformer is the one right answer for indoor industrial plant distribution systems.

For complete information call your Westinghouse Office, or write Westinghouse Electric & Manufacturing Company, Box 868, Pittsburgh 30, Pa.

J-70434

Westinghouse

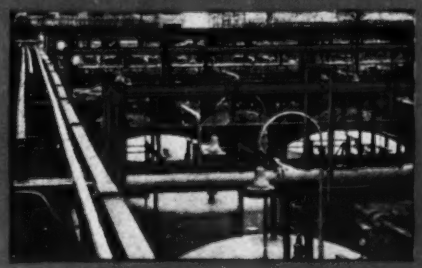
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Packaged Power

WAR DEPENDS ON RUBBER—

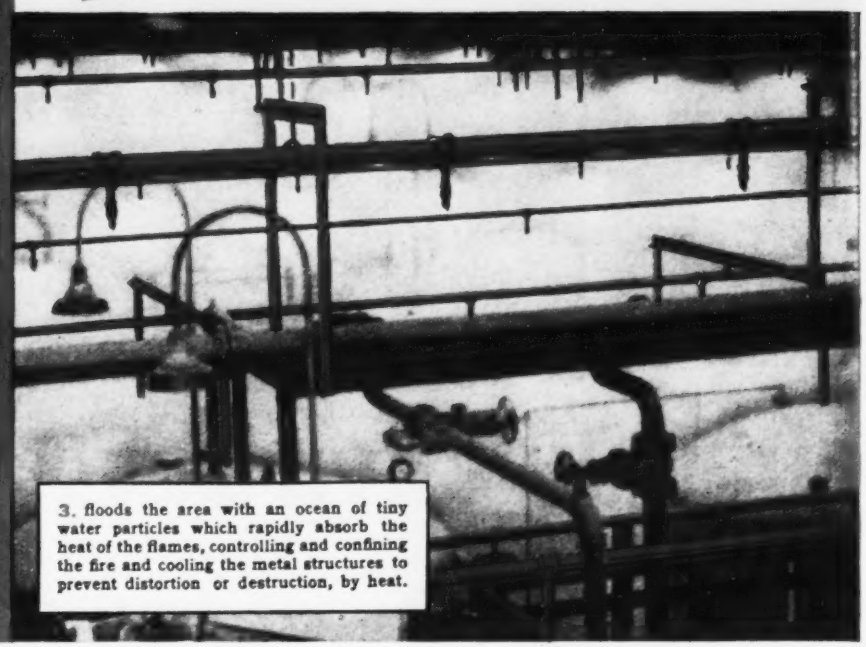
SYNTHETIC RUBBER depends on . . .

WaterFOG



1. A leak permitting escape of highly flammable vapors from these huge butadiene and styrene production tanks . . . a spark . . . and the entire area of this important synthetic rubber plant would be threatened with destruction . . . EXCEPT FOR

2. . . . the fact that this synthetic rubber plant is protected by the most effective method of cooling and confining fires in highly flammable vapors or liquids. Release of WaterFOG (two systems going into operation in this picture) . . .



3. floods the area with an ocean of tiny water particles which rapidly absorb the heat of the flames, controlling and confining the fire and cooling the metal structures to prevent distortion or destruction, by heat.

Rockwood WaterFOG
strips flammable vapors of their threat

At one of the country's largest synthetic rubber plants, five WaterFOG systems — part of a completely engineered Rockwood fire protection system — stand watch over 34 huge processing and storage tanks. The tanks they guard, measuring 18½ feet high by 8 to 10½ feet in diameter, contain butadiene and styrene . . . extremely vulnerable in case of fire.

The WaterFOG systems may be operated simultaneously, separately, or in any combination. A WaterFOG curtain between every other row of tanks, goes into action whenever the system on either side starts operating. Thus protection is provided over, around and under every tank.

WaterFOG — created by impinging streams of water from Rockwood nozzles — is effective on flammable liquid or vapor fires where spray and solid streams are frequently unsafe. It absorbs heat faster, retards vaporization, doesn't splash. Both Underwriters' Laboratories and Associated Factory Mutuals approve Rockwood WaterFOG installations of fixed piping. WaterFOG nozzles for hose lines also available. Write for Bulletin 123.

ROCKWOOD SPRINKLER COMPANY
62 Harlow Street, Worcester 5, Mass.
Specialists in Fire Protection Engineering, Equipment and Installation since 1907

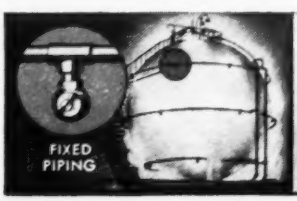
TYPICAL WaterFOG APPLICATIONS

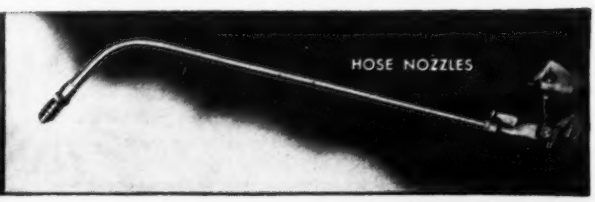
transformers	oil storage
oil switches	regulators
generators	etc.
paint shops	

Water Engineered by Rockwood
Cools, Confines, Smothers Oil Fires

ARMY E NAVY

ROCKWOOD WaterFOG

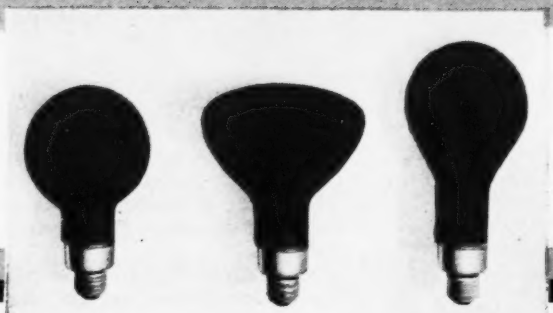




THE NEW Infra-Red IMPROVED DISCOVERY...

PENETRAY
DRYING LAMPS

For better, faster, cheaper, easier baking, drying and dehydrating



Literature will be sent or factory sales engineer will call upon request

1- Penetray's exclusive amber ceramic coating improves wavelength, producing more intensive color, thorough curing and superior polymerization.

2- Glare is minimum and reduced insect attraction insures cleaner work.

3- Energy distribution uniformity permits of lower wattage on many types of work.

4- Your own testing is invited. In metallic finishing compare gloss and color; make corrosion and abrasives tests.

LEARN TO SAY
»PENETRAY

DEVELOPED AND MANUFACTURED BY
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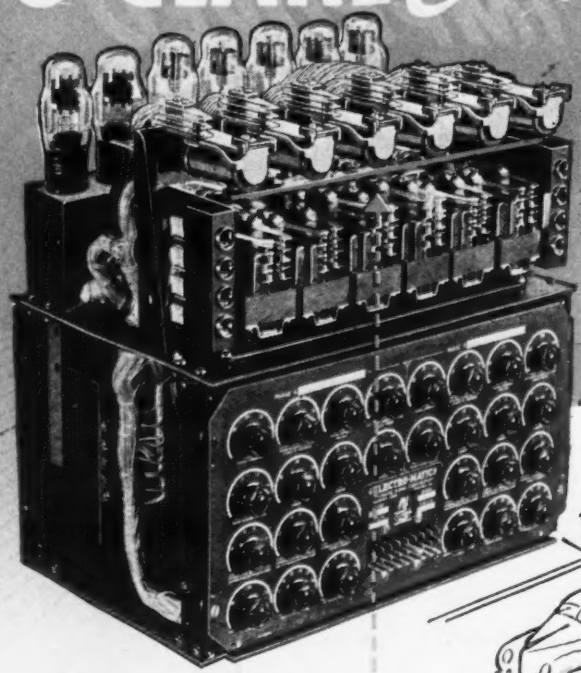
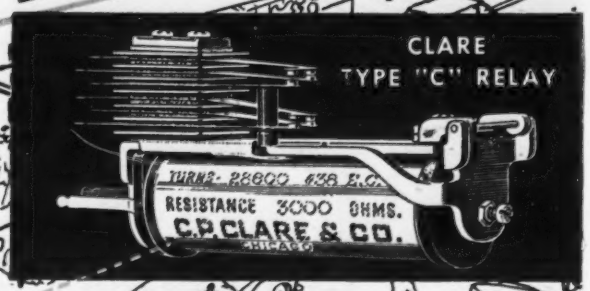
CORPORATION » TOLEDO 3, OHIO

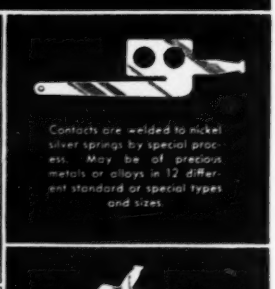
6 CLARE "Custom Built" RELAYS



Change Lights in Electro-Matic Dispatcher in Response to Electronic Impulses!

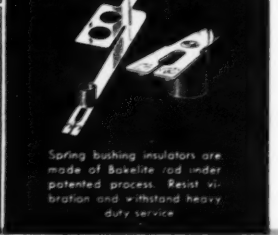


Double arm armature assembly of stainless steel shaft, operating in a marine brass yoke. Heelpiece, core and armature assembly are of magnetic metal.



Contacts are welded to nickel silver springs by special process. May be of precious metals or alloys in 12 different standard or special types and sizes.

High voltage spring pile-up insulators of special heat-treated Bakelite. Has minimum cold flow properties, low moisture absorption content and permits punching without cracks or checks.



Spring bushing insulators are made of Bakelite rod under patented process. Resist vibration and withstand heavy duty service.

The Electro-Matic Two-Phase Dispatcher, manufactured by the Automatic Signal Corporation of East Norwalk, Conn., is a distinct advance in modern traffic control. It literally counts and times the cars in heavy traffic.

Six Clare Type "C" Relays open and close the contacts . . . cause the lights to change at the proper time . . . on actuation by electronic impulses.

These Clare "Custom-Built" Relays were selected by the Automatic Signal Corporation for this "super traffic cop" because of their accurate and precise operation, their ability to open and close circuits quickly and their rugged construction of the finest materials.

The Clare Type "C" d.c. Relay, like all Clare "Custom-Built" Relays, has that unusual flexibility which permits design and production engineers to have just the relay for the specific function required.

By "custom-building" to exact specifications, Clare Relays assure exceptional service in spots where hard usage, long life and absolute dependability are prime factors. Special features of Clare construction adequately meet severe conditions of temperature, humidity, atmospheric pressure, voltage and vibration.

Pictured and described here are a few of these Clare "Custom-Built" Relay features that make it possible for Clare Relays to reduce overall relay cost, simplify installation and insure more dependable performance in such applications as sequence control of machine tools, radio, radar or other electronic controls, electric eye controls, counting equipment and alarm systems.

Whatever your design problem, there is a Clare "Custom-Built" Relay to meet it. Clare engineers are ready at all times to assist in developing a relay "custom-built" to your exact requirements. Send for the Clare catalog and data book. Address: C. P. CLARE & CO., 4719 West Sunnyside Avenue, Chicago 30, Illinois. Sales engineers in all principal cities. Cable Address: CLARELAY.

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical, Electronic and Industrial Use

SUCCESS has Crowned our Efforts

TO COMBINE ALL REQUIRED VALUES INTO A SINGLE GRADE OF TUBING!

No longer is it necessary to specify one type of tubing for dielectric, another for non-fraying ends, another for flexibility and so on for heat, moisture and solvent resistance or for slow burning.

ALL OF THESE QUALITIES ARE BUILT INTO MITCHELL-RAND'S TRIPLE-STRENGTH FIBERGLAS TUBING

TRIPLE-STRENGTH

WILL remain flexible, withstand high dielectric, high humidity, moisture, solvents, twisting, bending.

WON'T bruise or fray, stiffen, break down under high dielectric, rough handling, twisting or bending.

SPECIFY MITCHELL-RAND'S TRIPLE STRENGTH FIBERGLAS TUBING AND OBTAIN ALL YOUR REQUIRED VALUES IN ONE!

TRIPLE STRENGTH Fiberglas Tubing can be used on the leads of transformers which are to be potted in high melting point compounds and in assemblies which after they are completed are dipped and baked for six hours at 250° F. to cure the varnish coating of the assembly.

MITCHELL-RAND *for* 56 YEARS THE ELECTRICAL INSULATION HEADQUARTERS

EST. 1889

FREE FOR YOUR ASKING. A Sample Card of Varnished Tubings, samples to fit sizes from B&S wire 220 (.032") to 20 (.325")... a Wall Chart with quick easy to read reference tables of electrical symbols, capacity of conductors, dielectric averages of insulating materials, mathematical tables, tap drill sizes, standards of varnished tubing sizes... Wax and Compound Guide Book and the M-R Book of Electrical Insulations.

ALL ARE FREE FOR YOUR ASKING . . . WRITE FOR THEM ON YOUR LETTERHEAD

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Insulating Varnishes of all types
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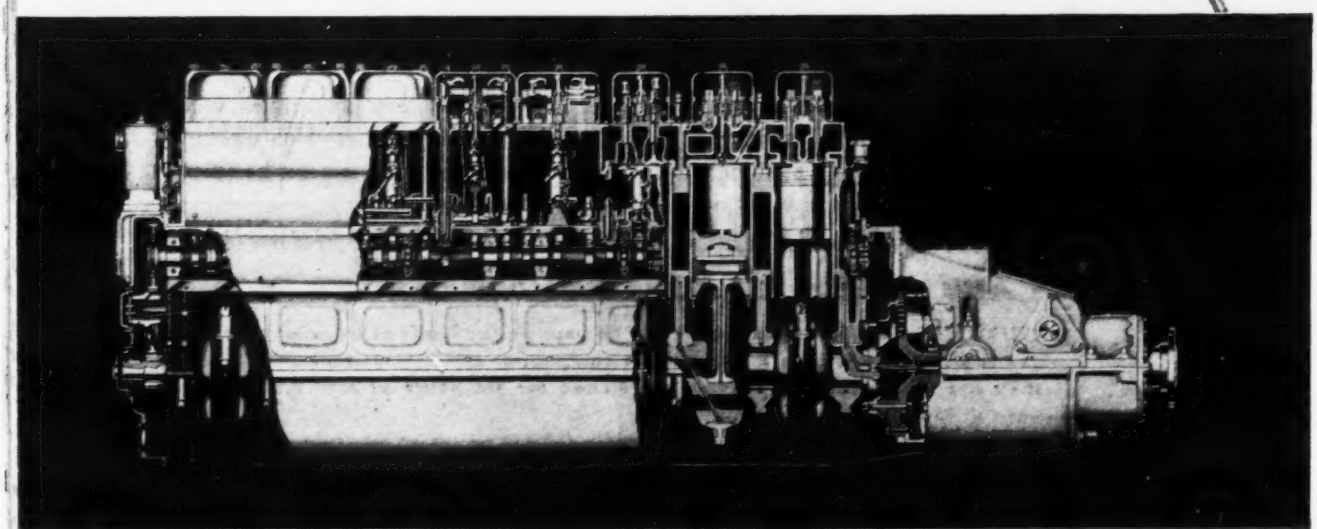
Built with watch-like precision

LIKE a fine watch it requires exacting precision and tolances to build a diesel engine compact as the new Sterling iking—an engine that gives you e streamlined efficiency of a soline engine of the same ower rating—plus the economy diesel fuel—an engine which is the result of fifteen years of research by a company whose name for nearly half a century has been synonymous with dependability and quality.

The Sterling Viking Diesel is ready now to replace your overworked industrial power plant or to add greater cruising range to your post-war boat. Write for complete specifications of this newest addition to a line of Sterling engines—diesel, gasoline, or gas—ranging in power from 85 hp. to 1800 hp.

"KEEP BUYING WAR BONDS"



STERLING *VIKING DIESEL*

STERLING ENGINE COMPANY 1292 Niagara St., Buffalo 13, N. Y.

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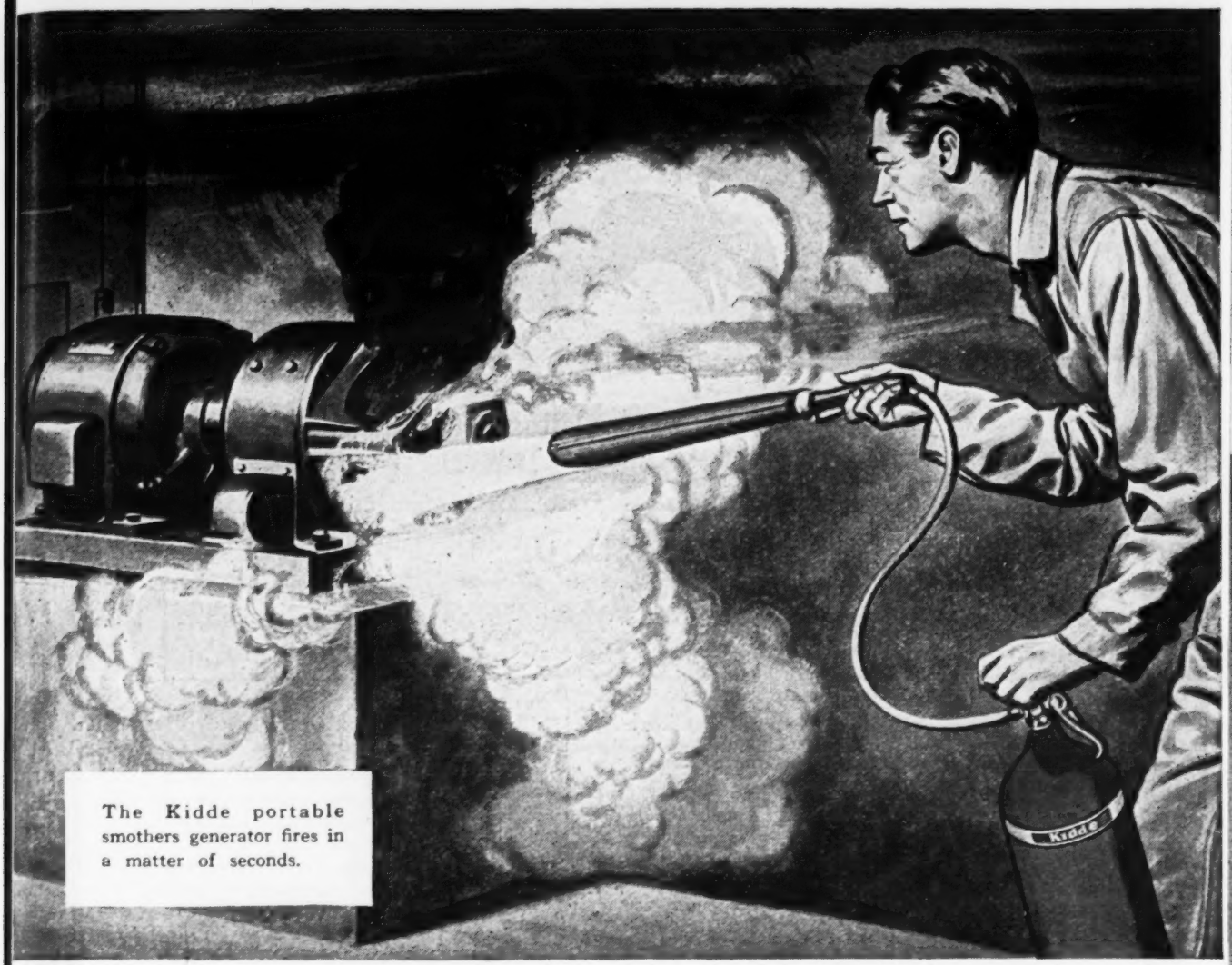

The Kidde portable smothers generator fires in a matter of seconds.

KIDDE GETS 'EM YOUNG . . . and treats 'em rough!

Big electrical fires begin life as little ones. But they grow fast and soon become hard-to-handle and tough. Ordinary water-type extinguishers cannot stop the electrical (class C) blazes, but *all* laboratories approve the Kidde method of smothering them under a barrage of carbon dioxide gas.

Through specially designed nozzles, the Kidde portable discharges fire-smothering carbon dioxide gas which plunges through small openings in housings, between mazes of wiring, and around obstacles and corners, to suffocate the flame almost instantly . . . *in a matter of seconds.*

Moreover, the Kidde portable leaves no after-fire mess to be cleaned up and does not damage electrical insulation. For carbon dioxide gas is DRY, inert and nontoxic. Consequently, Kidde equipment is recognized as one of the fastest, cleanest and safest portable fire extinguishers in use today.

For safety's sake, check the accompanying list of typical electrical fire hazards. If you have one of the tough-fire hazards in your plant, call in a Kidde representative. You'll find him wise in the ways of fire fighting. Drop us a line.

KIDDE KILLS TOUGH FIRES

- Generators
- Motors
- Condensers
- Converters
- Transformers
- Switchgear
- Lightning Arresters
- Rectifiers
- Regulators
- Flammable Liquid Storage
- Filter Recirculation

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Walter Kidde & Company, Inc. • 140 Cedar Street, New York 6, N. Y.

A NEW BOOKLET JUST PUBLISHED

FOR ELECTRICAL

A SAMPLE PAGE

C-D Electrical Insulating Materials

V. Arc Resistance Tests

By E. O. HAUSMANN

The A.S.T.M. calls it D-495: A flat portion of the sample is placed beneath the points of two tungsten-tipped electrodes, which have been adjusted to a gap of 0.320 inches, and a high-voltage, low-current AC arc is increased at one-minute intervals until the material fails by becoming conducting. The frequency is 60 cycles per second, the open-circuit voltage is 12 to 15 kilovolts, and the sequence of current steps is as follows:

Sequence of Current Steps

Current, Milliamperes	Time Cycle	Approximate Rate of Heat Generation, Watts	Total Time, Seconds
10	¼ sec. on, 1¾ sec. off	3	60
10	¼ sec. on, ¾ sec. off	6	120
10	¼ sec. on, ¼ sec. off	12	180
10	continuous	34	240
20	continuous	34	300
30	continuous	45	360
40	continuous	56	420

This progressive increase is carried either to failure of the material or until the current has reached 100 milliamperes, but is not continued beyond this latter point for fear of burning the electrodes. However, practically all materials will have failed before this.

The first three steps in the above table makes use of an interrupted current cycle since a less severe condition than a continuous 10 milliampere arc is desired but a lower current arc would neither be steady nor impeccably continuous. Hence the interrupted arc. The surface of the sample should be clean and dry, for the presence of dirt, grease, moisture, or dust can seriously alter the results. Also, the Electrodes must be kept clean or wide variations in results will be attained. Even so, there will be a certain amount of variation, depending upon the by no means constant length or course of the track which appears in the test piece. This track is equivalent to a burnt pathway, for the sample is carbonized by the passage of the arc. Considerable heat is generated as can be seen in the table, and this is a contributing factor in the breakdown; in fact, most organic materials will emit acrid smoke from the test area just before the actual tracking takes place.

Material	Arc Resistance (seconds)
Diamond Vulcanized Fibre	140
Vulcoid	120
Diamond Dilecto (laminated fibre)	100
Dilectene	10
Dilecto, Grades X, XP, XXHV, XXARC	10
Dilecto, Grade XX, XXP, XXX XXXP, A, AA, C, CE, L, LE	4
Celoron	4

In most insulating problems, the information obtained by this test is of no use whatsoever. But in the case of such equipment as circuit breakers, or switches, or similar applications where there exists the possibility of arcing over the material, then it becomes of vital importance. The arc should certainly not be formed through the material as readily as through air, and the material should be of such a nature that arcs may, if necessary (or if accidental) flash across its surface without setting up a permanent track, which would allow conduction along this carbonized path and eliminate the usefulness of the dielectric. This latter possibility could be definitely dangerous in a piece of improperly-designed equipment. It should also be remembered that a high energy arc may of course cause tracking to take place much more readily than a low energy arc; this statement may seem obvious, but it not only stresses the fact that the insulation should be designed to match the equipment and the circuits but also covers the case where a low energy arc is coupled with surrounding requirements that may make it advisable to use a material whose arc resistance *per se* seems dangerously low.

When interpreting either test results or average values given for an insulating material, it is best to proceed with care for the truth of the matter is that this test has been designed more particularly to classify materials into types than into grades. Unless the differences in values are on the order of 2 to 1, these differences are practically meaningless. With sufficient experience and particularly if the actual testing itself can be observed, it is possible to draw finer distinctions, but in general any tendency to consider as significant results varying, for example, from a value of 10 to one of 14 seconds would be patently absurd except in the case of an arc of very low energy. This does not necessarily mean that test results cannot be listed as definite values, but rather that interpretation of such data should always be on the cautious side.

As might be expected from the considerable difference in the types of material, the products of Continental-Diamond show a wide range of arc resistance values, with Diamond Vulcanized Fibre heading the list and Dilecto and Celoron well down at the bottom.

With the help of special finishing varnishes it is of course possible to raise the arc resistance of Dilecto to values as high as 100 seconds. Whether or not this step is taken will depend upon the surrounding conditions of the application.

ENGINEERS CONCERNED WITH . . .

Electrical Insulating Materials

Here is a new, practical Booklet, prepared to answer the questions and meet the needs of engineers who are contemplating the use of laminated plastics, vulcanized fibre, or other insulating materials in their postwar products. It contains highly useful data on 9 different tests, and much information on insulating materials. Data includes properties — forms — graphs — fabrication — design — uses. It will pay you to write immediately for a complimentary copy.

30 PAGES OF CONTENTS INCLUDING—

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Yes... 30 pages of authoritative data and test results—yours for the asking!

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The Plastics

DILECTO—A Laminated Phenolic.

CELORON—A Molded Phenolic.

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HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE

VULCOID—Resin Impregnated Vulcanized Fibre.

MICABOND—Built-Up Mica Electrical Insulation.

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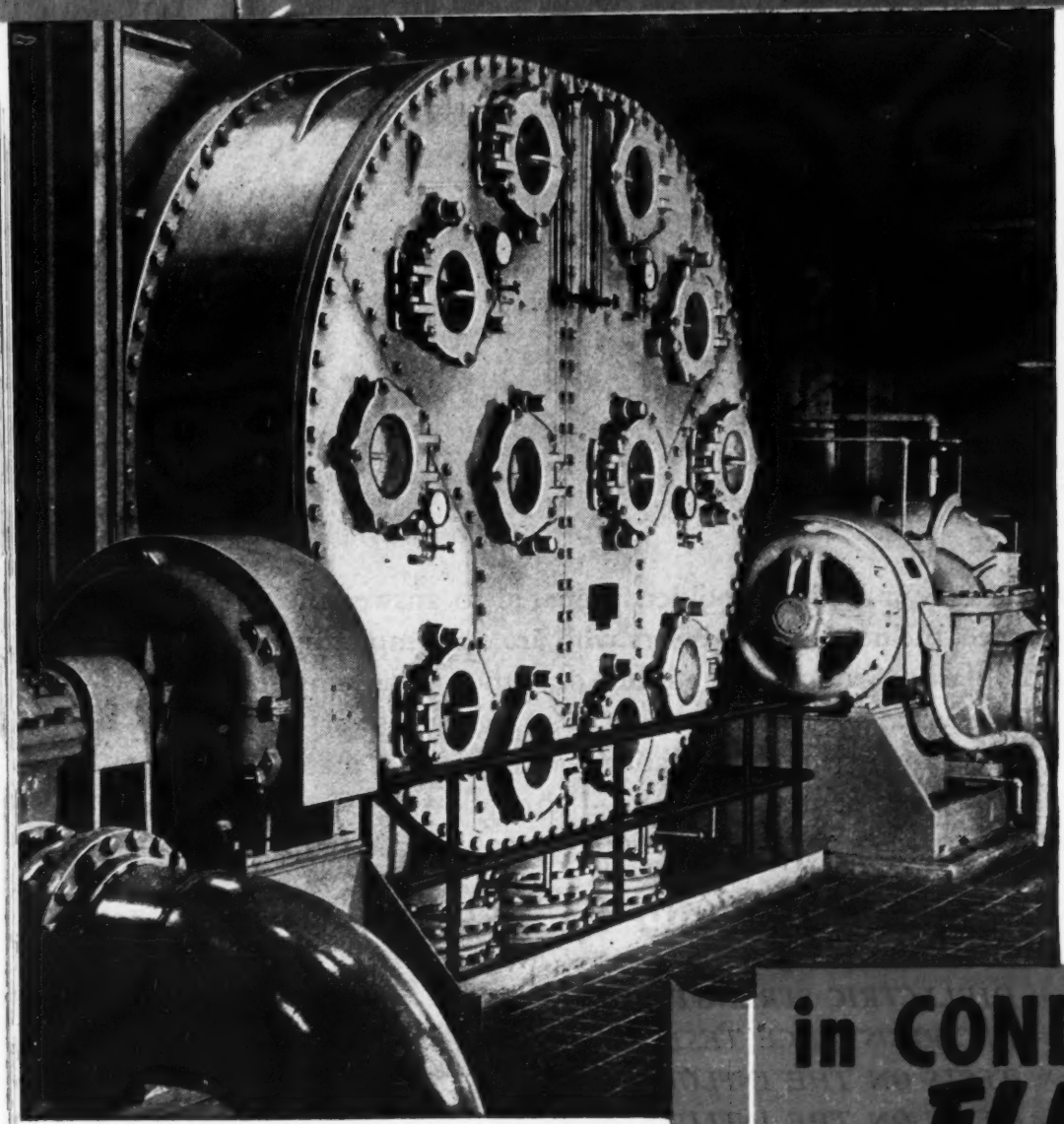


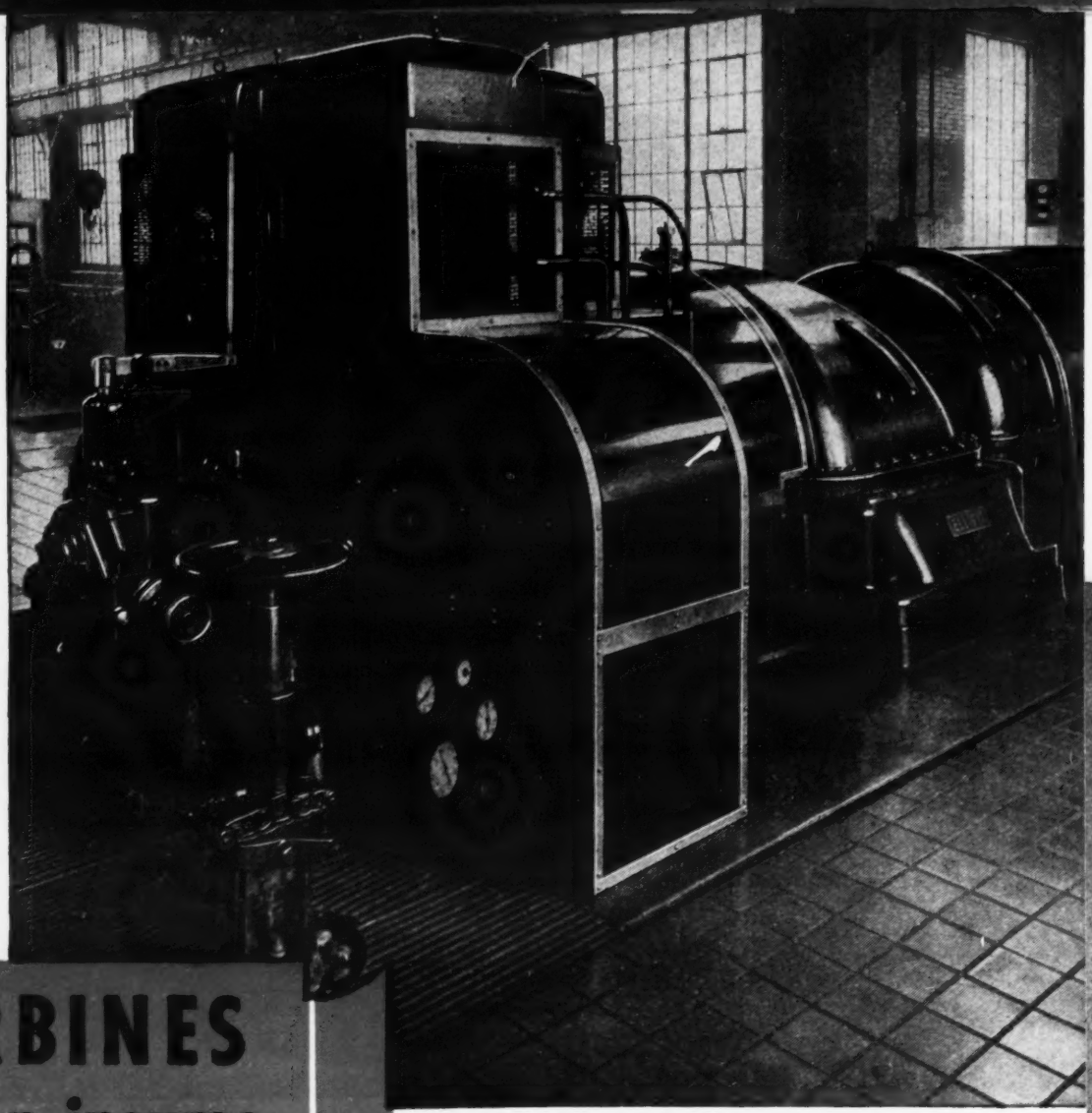
Elliott 27,000-sq. ft. surface condenser.

in CONDENSERS ... ELLIOTT outstanding

The many factors upon which condenser efficiency depends have been for years the subject of research by Elliott engineers. The arrangement and spacing of tubes to insure maximum contact with incoming steam, regulation of steam velocity, and maximum steam penetration; placing of tube supports to provide complete longitudinal steam distribution with minimum pressure drop; water collecting plates to prevent blanketing of tubes in the lower half of the condenser. And all other details to insure maximum condensing effect at lowest pumping and auxiliary costs.

Elliott condensers are "tailor-made" for the installations they serve. Their sound performance is amply demonstrated in many plants.

ELLIOTT



Elliott 6,000-kw turbine-generator unit.

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ngineering insures erformance

e development of today's Elliott turbines is the reward of over forty ars of intensive effort. It has been a case of "making haste slowly"—of oiding revolutionary or extreme developments, of adopting improvents only after conclusive test—while at the same time never ceasing the fort for better turbine performance. This has involved constant modifications in workmanship as well as in design, the setting up of new, closer curacy standards, of new, finer inspection procedure. And the working gether of design engineers and shop staff with a single aim—to build a rbine better, if possible, than was ever built before.

When you need turbines—either as units with their generators, or for echanical drive—talk it over with Elliott engineers.

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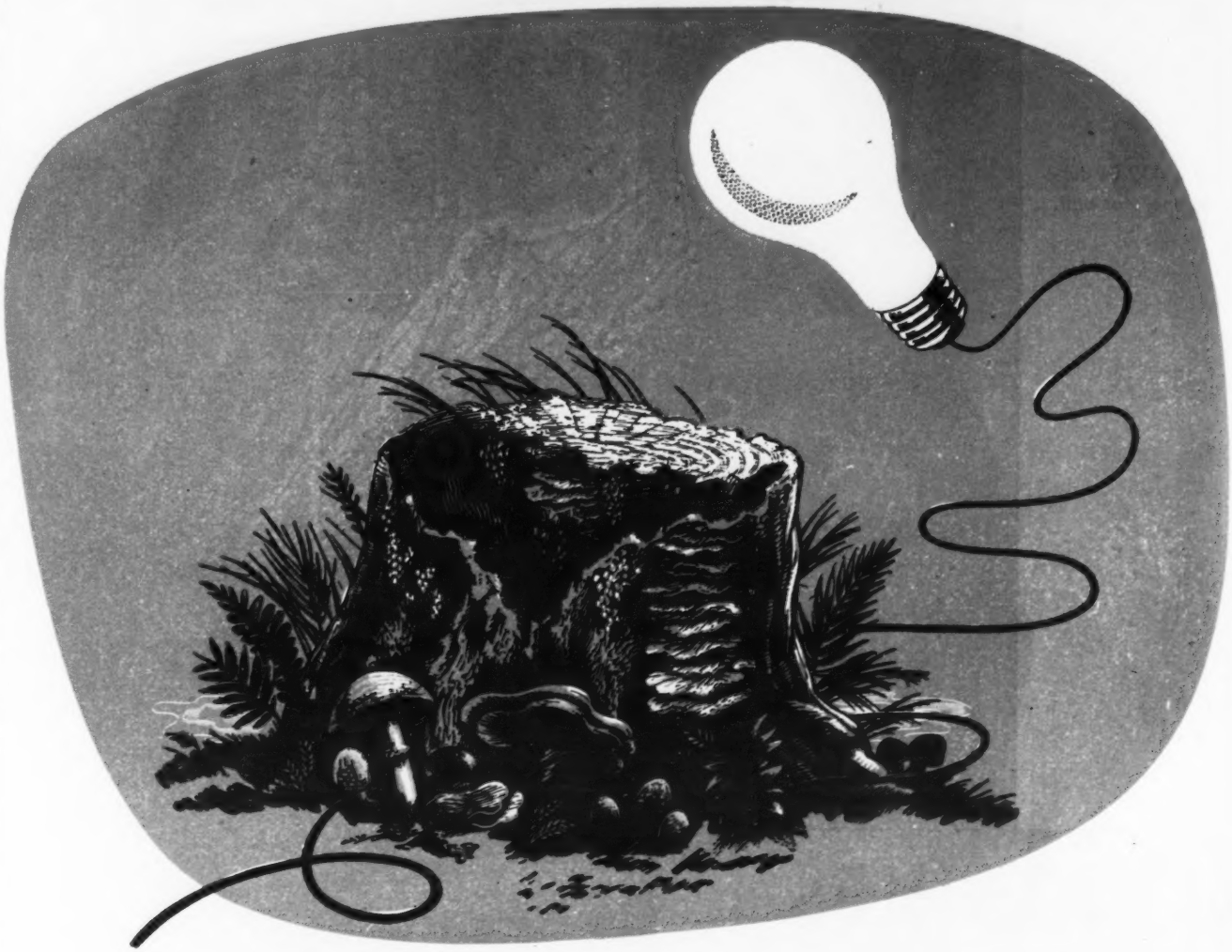


Laytex surprised even its creators!

It isn't often that one wire gets a world-wide action test in a world-wide laboratory. But Laytex — the original light-weight, small diameter wire — has had just that, and has come through with flying colors.

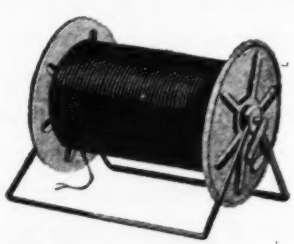
Laytex-insulated wire has followed our armed forces through arctic cold, tropic heat and moisture. It has defied insects and mold. It has been battle-tested under the most extreme conditions — and has stood up so well that it surprised even *us!*

Laytex has a record of delivering *more* electricity, *more* dependably, in *more* different jobs than any other wire we know.

Right now the entire output of Laytex Wires and Cables is going to the Armed Forces. But the day is steadily drawing nearer when manufacture will be resumed for Buildings, Police and Fire Alarms, Communications, Signalling, Power, Control, and other exacting services.

SERVING THROUGH SCIENCE TO PIONEER A NEW ELECTRICAL ERA

RUBBER INSULATION AT ITS BEST



U.S. Laytex

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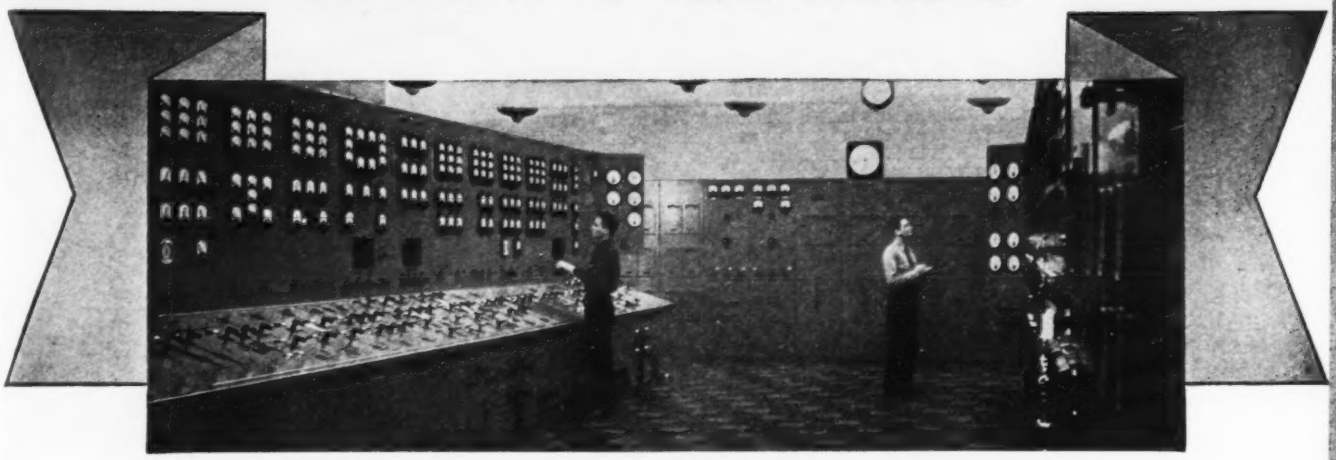
Exide BATTERIES



Serving Central Stations from Coast to Coast

Along nearly every degree of latitude from coast to coast, great Central Stations are pouring forth their mighty power, spinning the wheels of industry, and lighting city streets and homes and other buildings. Exide batteries are in most of these power stations performing control bus operation and other storage battery duties.

Exide makes several types of storage batteries for control bus operation. These batteries have earned the confidence of engineers everywhere, and their widespread use in public utilities and private industrial plants is proof of their dependability, long-life and ease of maintenance. When you buy an Exide, you *Buy* to *Last.*

Whatever your battery problems, Exide engineers will be glad to help you solve them.

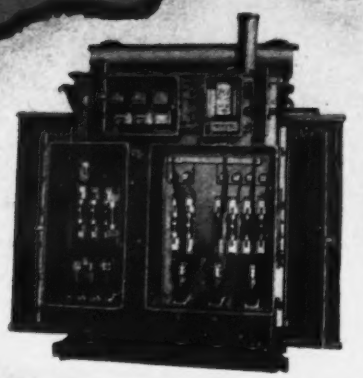
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

"SPECIAL" features of Standard transformers

TRADE MARK

When a transformer installation imposes "special" requirements, it is well to remember that STANDARD makes a specialty of adjusting and adapting regular designs to meet special conditions. The flexibility of our engineering and manufacturing set-up permits us to do this easily and quickly.

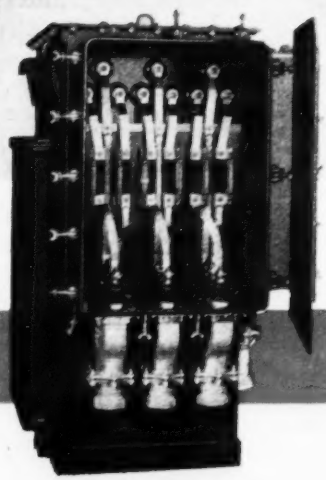
The examples shown here, although only an indication of our experience along this line, may suggest means of improving your present or proposed installations.



1500 KVA unit substation with meters, relays and low voltage fuses included.

Dry type transformer with fans for automatic accelerated cooling.

Two secondary transformer with terminal chamber including current transformers and pot heads for one and throat on other.



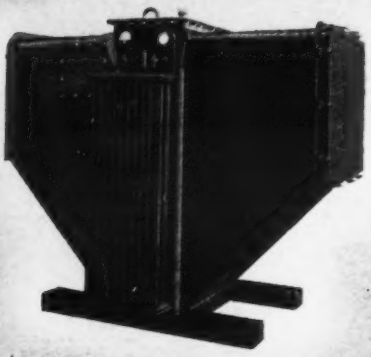
Weather proof compartment for fuses on low voltage circuits.

THE STANDARD

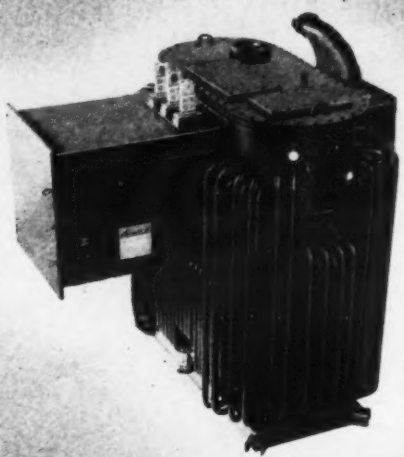
Makers of Transformers for : Distributi

WARREN, OHIO

are designed to meet your "SPECIAL" conditions

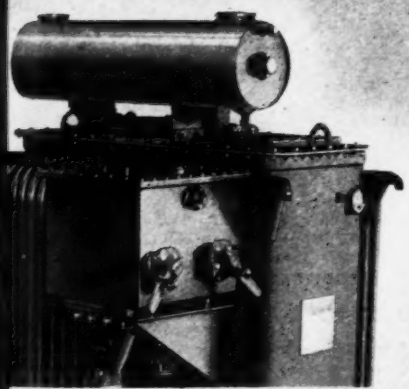


200 KVA unit substation with compartments housing metering and circuit breaker equipment.

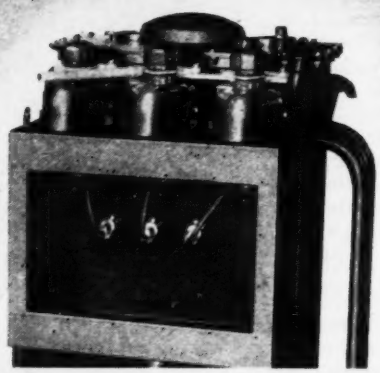


Automatic circuit breaker mounted on 750 KVA transformer. Terminal chamber and pot head on high voltage side.

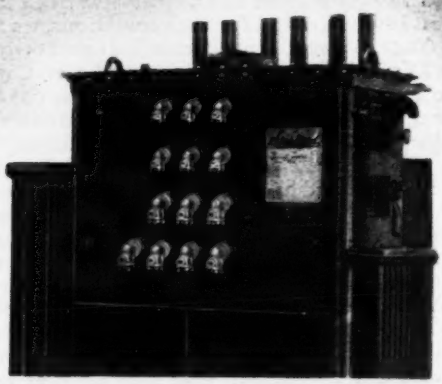
Special design of rollers, arranged for moving transformer in either of two directions.



Looping feeder oil filled switch mounted on 600 KVA three phase transformer.



Gang operated oil fused switch mounted on high voltage compartment of 75 KVA ASKAREL filled transformer.



Askarel filled 200 KVA transformer with special secondary taps.

TRANSFORMER • COMPANY

ower...Metering...Street Lighting...Testing...Dry and Liquid Filled Types

Offices in Principal Cities

POWER PLANT ENGINEERS...

COMBAT POLLUTED BRACKISH WATERS

WITH BRIDGEPORT

DURONZE IV

Seaboard power plants which must use brackish water polluted with sewage and industrial waste have a corrosion problem which is too severe for ordinary tubing. This condition is generally made still worse by both overwork due to war production and unavoidable neglect because of critical labor shortage. For such conditions, we recommend DURONZE IV, which under actual use has shown superiority over Admiralty, Aluminum Brass, and even Cupro Nickel!

To anticipate shutdowns from sudden condenser tube failure, power plant engineers should periodically examine condenser tubes selected from several sections. Our laboratory will gladly help by advising how these sample tubes should be marked and will even submit a report estimating how much life can be expected from them. The operating engineer should, of course, furnish our laboratory with complete information regarding water conditions, tube life and other necessary facts.

In some cases, a test installation involving several different alloys should be tried out under actual operating conditions. At any rate, contact your nearest Bridgeport office, and in the meantime, write for your free copy of Bridgeport's 112-page Condenser Tube Manual.

"Bridgeport" BRIDGEPORT BRASS COMPANY
BRIDGEPORT 2, CONN. • *Established 1865*

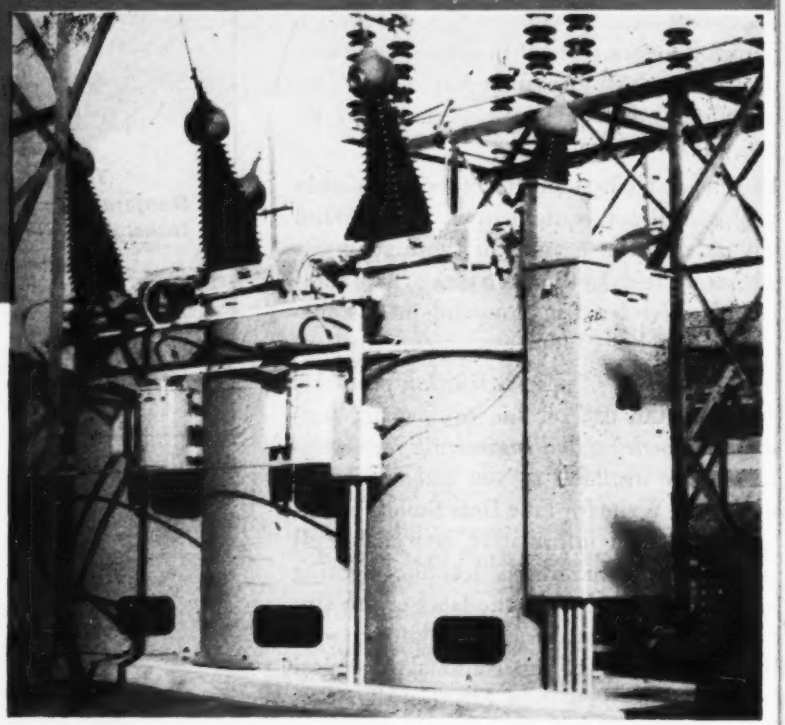
Condenser and Heat Exchanger Tubing — **PRODUCTS OF**

BRIDGEPORT BRASS

This FAST ARC Extinguishment assures 5-CYCLE Opening

PACIFIC ELECTRIC Breaker

TYPE RWE, 115 KV. and UP



Here's faster breaker operation that reduces system disturbance and gives better protection to your loads.

Their fast arc-extinguishing Expulsion Contacts together with the Motor-Compressed-Spring Operating Mechanism clear faults in 5 cycles.

And now 5-cycle clearance is standard with Pacific Electric Type RWE Breakers of 115-kv. and above.

Such instant protection further reduces maintenance by practically ending contact burning and by reducing oil deterioration. System disturbance during faults is also reduced.

The installation of these Pacific Electric Breakers is simple. Expensive station batteries, heavy cables, short-life rectifiers and air compressors are not needed, for the motor mechanism has strong springs—automatically prewound by a motor using low AC or DC current —for 5-cycle opening and fast reclosures.

It is the springs, not the motor, which operate the breaker. You have manual operation at the same uniform operating speed which permits you to use the breaker on the high-voltage side of transformers for perfect synchronizing, often making it unnecessary to purchase another breaker for the low-voltage side.

Made by specialists in high-voltage switching equipment for 39 years, you are assured of good design, the finest of bushings and sturdily-constructed parts. Utilities everywhere rely upon these breakers.

Ask for full details on our Type RWE Breakers which have 5-cycle opening and fast reclosures.

C. H. Cutter
1015 Securities Bldg.
Seattle 1, Wash.

G. B. Kirkwood
437 S. Hill St.
Los Angeles 13, Calif.

Pierce G. Fredericks
90 West St.
New York 6, N. Y.

J. E. Redmond Co.
448 W. Madison St.
Phoenix, Ariz.

Other Representatives in Principal Cities

Pacific Electric Mfg. Corporation

5815 THIRD ST., SAN FRANCISCO 24, CALIF. P. O. BOX 419, GARY, INDIANA

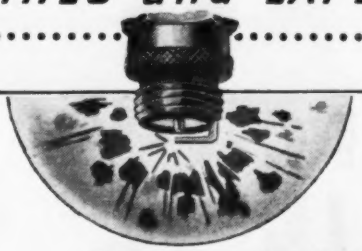
Severest Tests Show How Benjamin *Explosion-Proof* Fixtures

Insure against FIRES and EXPLOSIONS

Shown here are some of the exacting laboratory tests which Benjamin Explosion-Proof Lighting Equipment must pass . . . and do pass with flying colors!

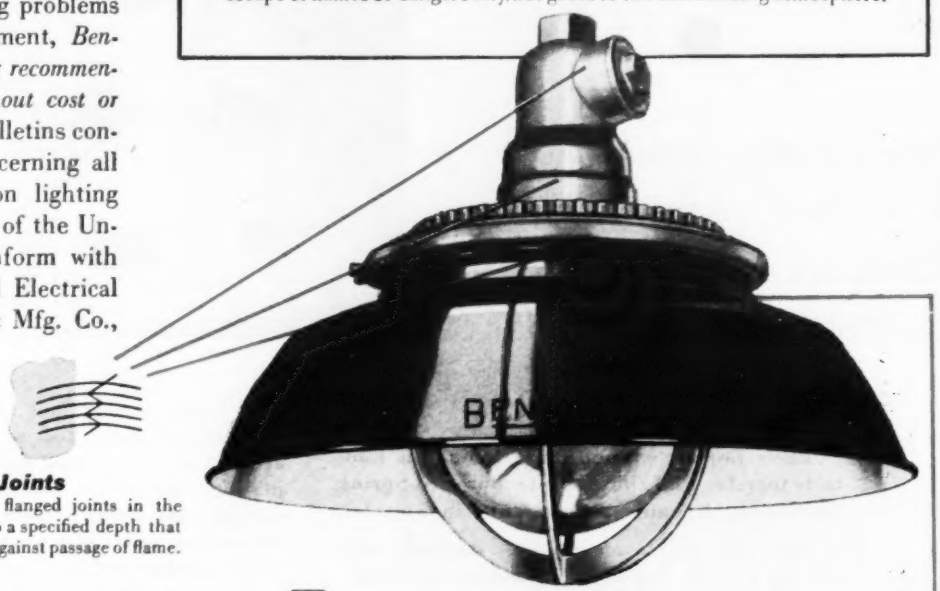
The dependability and safety of Benjamin Explosion-Proof equipment is to be found not only in the passing of these stringent laboratory tests but in the years of safe service it has rendered in thousands of installations throughout Industry.

In the solution of special lighting problems involving the use of this equipment, *Benjamin's experience and engineering recommendations are available to you without cost or obligation.* Write for Free Data Bulletins containing detailed information concerning all of Benjamin's hazardous location lighting units, all of which bear the label of the Underwriters' Laboratories and conform with all requirements of the National Electrical Code. Address Benjamin Electric Mfg. Co., Dept. **K,** Des Plaines, Illinois.



Thirty Severe Spark Plug Tests Demonstrate How Benjamin Explosion-Proof Fixtures Confine Explosions to Interior of Fixtures!

In this test, a spark plug is used to create ignition of explosive mixtures within the fixture. THIRTY EXPLOSIONS are thus created at 380 lbs. per sq. in. pressure! Benjamin units withstand these explosions. The fixture is neither destroyed nor damaged! There is no escape of flames or dangerously hot gases to the surrounding atmosphere.



Flame Proof Joints

All threaded and flanged joints in the fixture are made to a specified depth that positively insures against passage of flame.

Approved by Underwriters' Laboratories *for use in Class I, Group D hazardous locations. Under labeled re-examination service units are taken from the production line and periodically checked by the Underwriters' Laboratories to insure conformance to their rigid standards.*

FOR LIGHTING SUCH LOCATIONS AS . .

Oil Refineries, Lacquer Spray Painting, Natural Gas Plants, Dry Cleaning Plants, Artificial Leather Manufacturing, Paint and Varnish Works, Oil and Gas Wells, Pyroxylin Plastics, Moulding, Distilleries, Chemical Plants, Linoleum and Oilcloth Manufacturing. Pipe Line Pumping Stations, and other locations where highly flammable gases, mixtures or other highly flammable substances are used, handled, or stored in other than their original containers.

Temperature Controlled

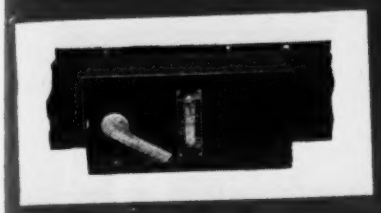
Every Benjamin Explosion-Proof fixture operates at a carefully controlled temperature that precludes any possibility of the fixture heat causing an explosion in the explosive atmosphere in which it is installed.

BENJAMIN TRADE MARK

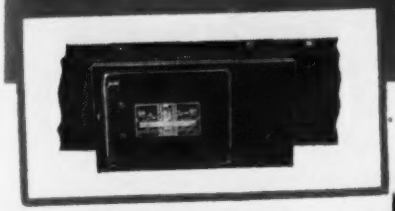
Lighting Equipment

Distributed Exclusively through Electrical Wholesalers

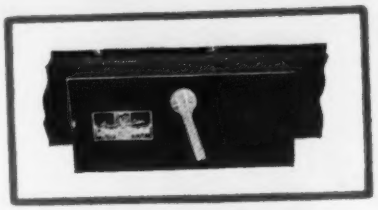
For every circuit protective purpose



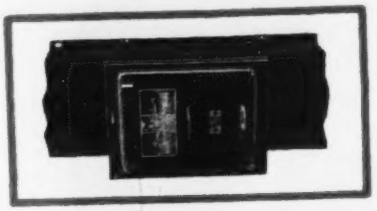
VACU-BREAK SWITCH PLUG



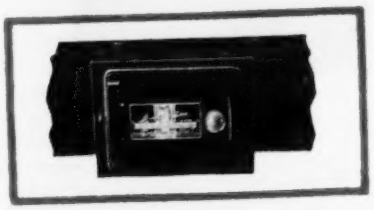
TYPE "PB" BUS PLUG



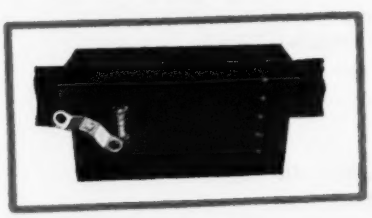
CIRCUIT BREAKER PLUG



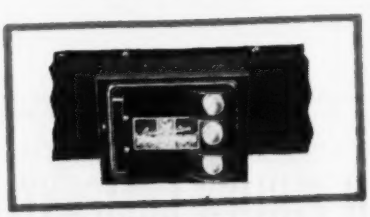
CIRCUIT MASTER PLUG



TEMPERATURE INDICATING PLUG



CAPACITOR PLUG



GROUND DETECTOR PLUG

BULLDOG BUStribution DUCT offers a plug *built for the job*

One of the outstanding advantages of the BullDog BUStribution DUCT system is the wide variety of circuit protective tap-off plugs available in standard pre-fabricated types.

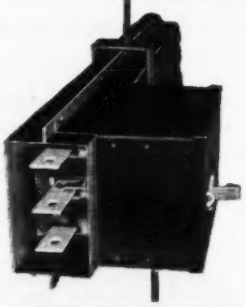
Designed to improve the efficiency of the system through maximum flexibility and adaptability, the standard BullDog Bus Plugs provide a convenient means of current take-off that is completely interchangeable for type, volts, poles and sizes.

All Bus Plugs fasten securely to the flanges of the duct section at the plug-in openings, may be mounted on either or both sides of the duct and require no auxiliary screw clamps or fittings.

Plugs may be removed from duct and moved to a new location at a minimum of labor expense and with no material loss, permitting rapid rearrangement of production machinery to meet expansion programs, change-overs or new production methods.

For complete information on the various BullDog Bus Plugs illustrated in this advertisement, write for our illustrated bulletin 427-2.

Manufacturers of a complete line of Vacu-Break Safety Switches, Panelboards, Switchboards, Circuit Master Breakers and BUStribution SYSTEMS.



PLUG MOUNTED ON DUCT
This end view of a plug mounted on duct shows how the copper "contact" fingers of the plug clamp over the bus bars in the duct.

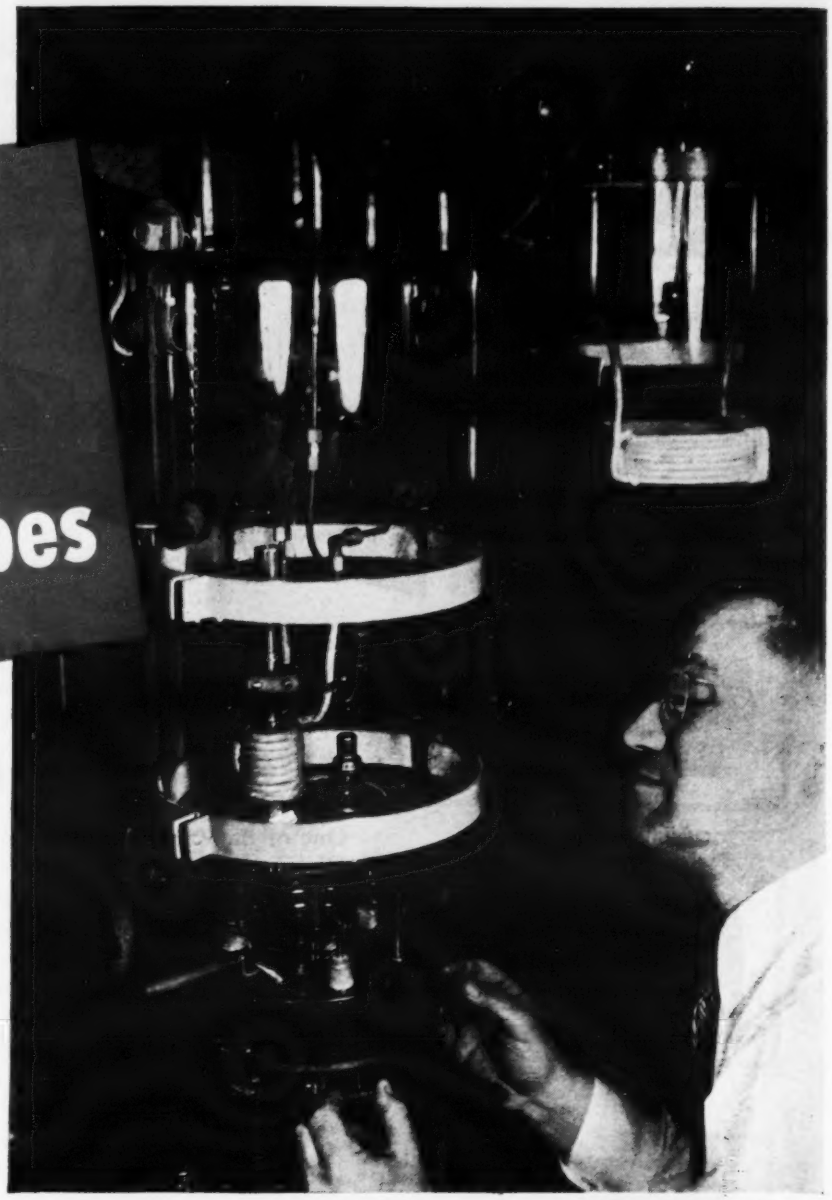
For a Bright Future
Buy More War Bonds

BULLDOG
ELECTRIC PRODUCTS CO.

BOX 177, R. PK. ANNEX
DETROIT 32, MICHIGAN
BullDog Electric Products of Canada, Ltd., Toronto, Ont.

Field Engineering Offices in All Principal Cities

A knack for making difficult tubes



The metal plate and grid terminal posts of an 833-A being bonded to the glass envelope by means of radio-frequency heating in a nitrogen atmosphere.

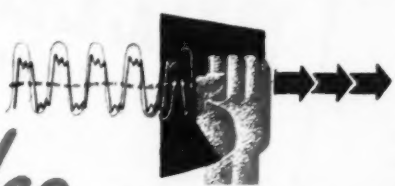
NORTH AMERICAN PHILIPS is one of the few producers of electronic tubes successfully manufacturing the type 833-A transmitting triode tube in quantity. The assembly alone alls for unusual skill and resourcefulness on he part of our engineers and craftsmen, and pecially designed equipment.

Due to the unique design of the 833-A, the late is supported from its own terminal post at he top of the glass envelope and the remaining lements from the base or stem. The tube must herefore be assembled in two sections and accuately joined on a glass lathe. Bonding of the etal grid and plate terminal posts to the glass ares is done by r-f induction heating, which is onfined to the sealing points only. This operation, lustrated, is completed in a matter of seconds.

The ability to produce such difficult tube ypes is the result of experience gained by an rganization with a background of over half a entury of research and development in the lectrical field. That is one of the reasons why manufacturers look to North American Philips as a reliable source of electronic tubes for their postwar requirements.

Although all the NORELCO tubes we produce now go to the armed forces, we invite inquiries from prospective users. A list of the tube types we are especially equipped to produce will be sent on request.

Write today for interesting booklet, describing the background of North American Philips in the science of electronics.



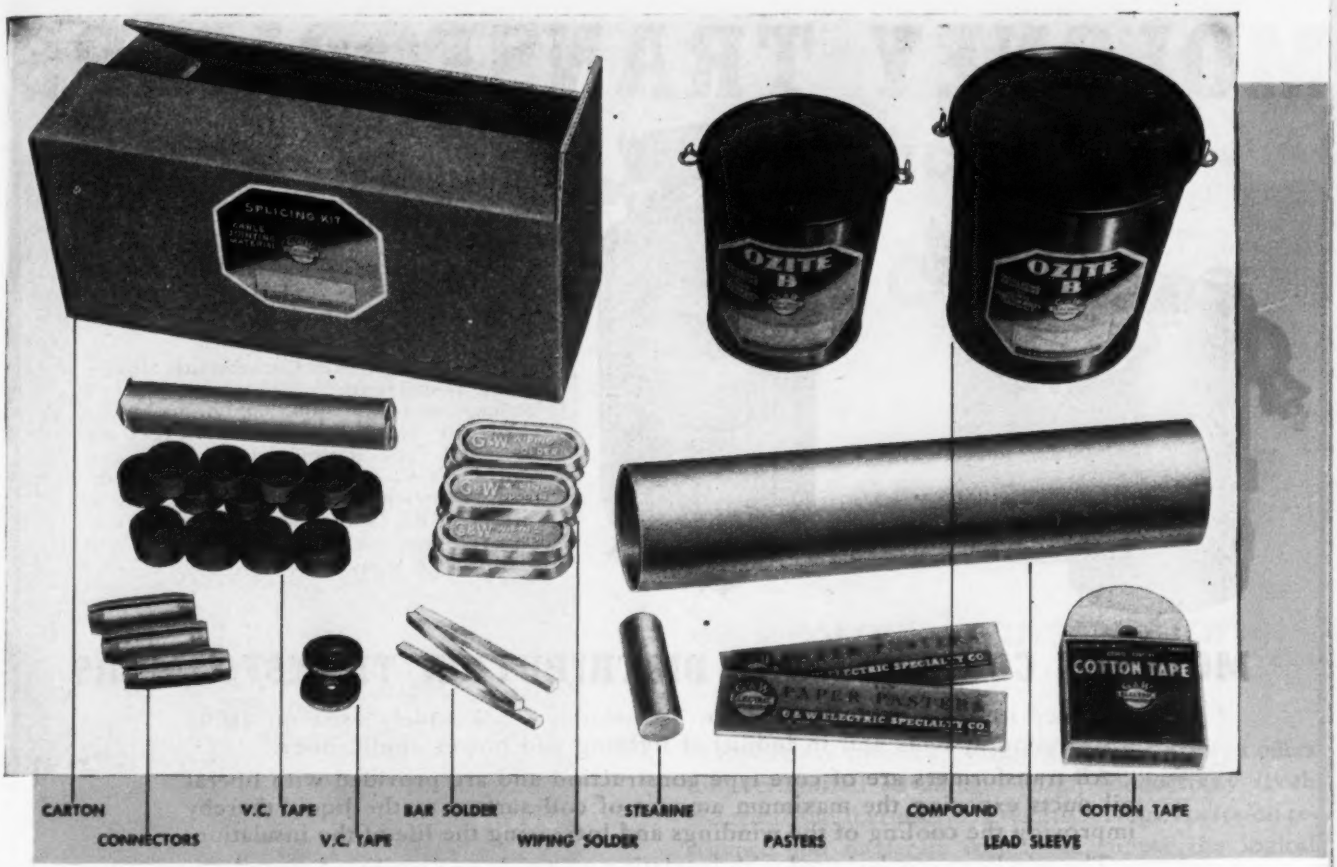
Norelco
Reg. U. S. Pat. Off.

Electronic Products by

NORELCO PRODUCTS: Quartz Oscillator Plates; Amplifier, Transmitting, Rectifier and Cathode Ray Tubes; Searchray (Industrial X-ray) Apparatus; X-ray Diffraction Apparatus; Medical X-ray Equipment, Tubes and Accessories; Tungsten and Molybdenum products; Fine Wire; Diamond Dies. • When in New York, be sure to visit our Industrial Electronics Showroom.

NORTH AMERICAN PHILIPS COMPANY, INC.

Dept. G1, 100 East 42nd Street, New York 17, N. Y.
Factories in Dobbs Ferry, N. Y.; Mount Vernon, N. Y. (Metalix Div.); Lewiston, Me. (Elmet Div.)



for good service on

SPLICING KITS *look to G & W*

You will find this a time-saving, trouble-saving, money-saving habit.

G & W now furnishes, usually from STOCK, unit packages of electric cable splicing material, "Splicing Kits" for all standard or special joints on rubber, varnished cambric or paper insulated (solid type) power cables and telephone cables.

Engineering service is available to customers in connection with the design and installation of cable joints for any type of service.

G & W has purchased the accessory business of General Cable Corp. and has secured the services of Dr. Wm. S. Brown, who brings 27 years of experience as a specialist on cable joint design and installation.

General Cable potheads, junction boxes, OZITE compound, and miscellaneous items of cable accessories are now manufactured by G & W.

Send for a copy of new bulletin CJ1, the first of a series on splicing kits.

W. S. Brown, Ph.D., formerly with General Cable Corp., has joined the G&W organization.

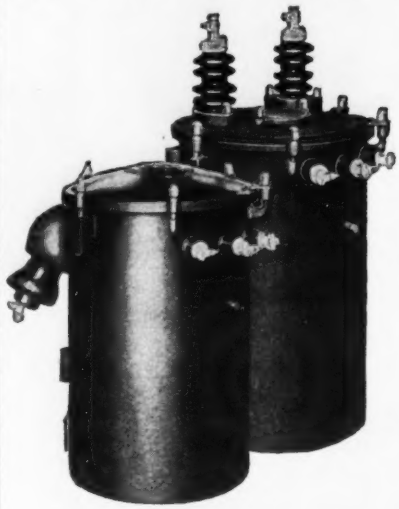
G & W ELECTRIC SPECIALTY CO.

7780 DANTE AVE. CHICAGO 19, ILL., U.S.A.

IN CANADA — POWERLITE DEVICES, LTD., TORONTO

POTHEADS • BOXES • OIL FUSE CUTOUTS • OIL SWITCHES • MULTITAPS

MOLONEY TRANSFORMERS



Single-phase Transformers

Conventional Single-phase Distribution Transformers are available in capacities from 1½ to 500 Kva, in voltages up to 66,000 volts.

Illustrated are small Conventional Single-phase Distribution Transformers typical of voltage ratings of 2400, 7200 or 13,200 to 120/240 volts. From left to right they are Type KL (pocket mounted HV bushings), and Type CL (cover mounted HV bushings) representative of sizes 1½ to 50 Kva, and Type KL (with tubes) representative of sizes 75 and 100 Kva. These conform to EEI-NEMA Standards.

MOLONEY CONVENTIONAL DISTRIBUTION TRANSFORMERS

Moloney Conventional Distribution Transformers are widely used on utility distribution systems and in industrial lighting and power applications.

All transformers are of core type construction and are provided with liberal oil ducts exposing the maximum amount of coil surface to the liquid thereby improving the cooling of the windings and increasing the life of the insulation.

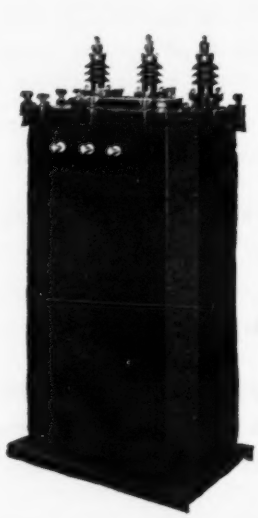
The windings are designed with insulating materials so distributed, as to keep the electrical stresses at a minimum. The insulation level is uniformly high, reducing the possibility of damage resulting from lightning surges. Bushings are coordinated with the winding insulation level so that in event of a surge the bushings flash over before the windings are damaged.

Secure the advantage of over 47 years of specialization in the manufacture of transformers by specifying Moloney transformers for your next installation.

Three-phase Transformers

Conventional Three-phase Distribution Transformers are available in capacities from 10 to 500 Kva in voltages up to 66,000 volts.

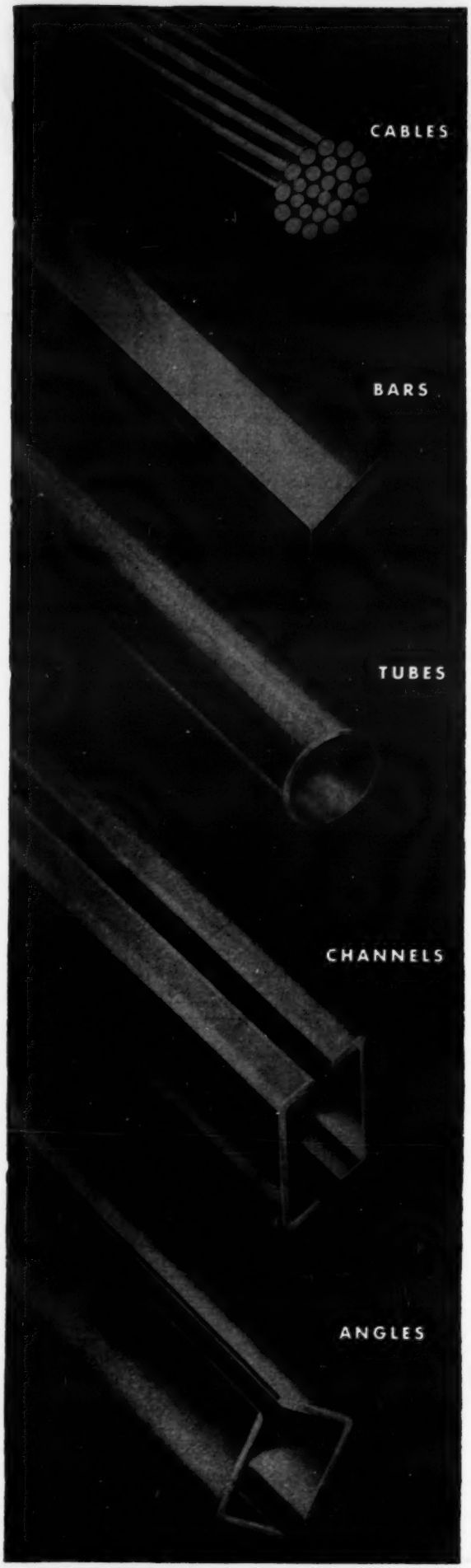
At right are illustrated small Conventional Three-phase Distribution Transformers of Moloney Type TCL design which includes cover mounted HV bushings and sidewall mounted LV bushings. The transformer on the left is typical of sizes 10 to 37½ Kva. The transformer on the right equipped with cooling tubes is typical of sizes from 50 to 200 Kva. These are also available in Type TKL having pocket mounted HV bushings and sidewall mounted LV bushings.



MOLONEY ELECTRIC COMPANY • ST. LOUIS, U. S. A.

SALES OFFICES

Alexandria, Va.....401 Doniphan Bldg.
Atlanta, Ga.....217 Whitehall St., S. W.
Birmingham, Ala.....1814 First Avenue, North
Bluefield, W. Va.....201 Union Street
Boston, Mass.....Statler Office Bldg.
Charlotte, N. C.....124 Brevard Court
Chicago, Ill.....100 West Monroe Street
Dallas, Tex.....709 Thomas Bldg.
Denver, Colo.....612 Insurance Bldg.
Detroit, Mich.....16125 Grand River Drive
744 New Center Bldg.
Grand Rapids, Mich.....412 Houseman Bldg.
Houston, Texas.....4411 Navigation Blvd.
Indianapolis, Ind.....909 Roosevelt Bldg.
Kansas City, Mo.....624 Dwight Bldg.
Knoxville, Tenn.....Harrill Hills
Los Angeles, Calif.....124 W. 4th St.
Minneapolis, Minn.....643 Midland Bank Bldg.
New Orleans, La.....428 Baher Bldg.
New York, N. Y.....55 Liberty Street
Omaha, Nebr.....503 Sunderland Bldg.
Pittsburgh, Pa.....937 Oliver Bldg.
Portland, Ore.....1233 N. W. 12th Avenue
St. Louis, Mo.....5390 Bircher Boulevard
Salt Lake City, Utah.....314 Kearns Bldg.
San Francisco, Calif.....420 Rialto Bldg.
Seattle, Wash.....532 First Avenue, South
Shreveport, La.....630 Spring Avenue



Anaconda Bus Conductors for LOW-LOSS Power Transmission

WHEN THERE'S electric power to transmit, COPPER offers long-recognized advantages. High conductivity (both electrical and thermal) . . . strength . . . high corrosion resistance and moderate cost make copper the logical choice for bus installations.

There's an Anaconda Copper Bus Conductor shape for every transmission requirement. Send for Bus Conductor Booklet, C-25, or consult with The American Brass Company Technical Department.

CABLES solve many problems in conducting extremely heavy currents in confined space or in connecting moving apparatus such as arc or resistance furnaces.

BARS requiring minimum space may be bent or twisted, connected to apparatus without special joint preparation, and in laminated construction have unlimited d.c. capacity.

TUBES provide the highest bus conductor efficiency at a.c. frequencies, have greater rigidity, and may be oil or water cooled.

CHANNELS with large surface area and ventilation feature, reduce temperature rise, have greater rigidity for long runs than tubes, flat surfaces for tap-off.

ANGLES ventilated hollow busses with highest rate of heat dissipation, handle greater current density but require more space for installation. 44111

ANACONDA

Anaconda Copper

THE AMERICAN BRASS COMPANY

Subsidiary of Anaconda Copper Mining Company

General Offices: Waterbury 88, Connecticut

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

6,700,000 LB of NEW STEAM

CAPACITIES

Unit capacities range from 50,000 lb to 650,000 lb of steam per hour. The smaller sizes include VU units of the type illustrated on the opposite page, varying from 50,000 to 200,000 lb. The larger units range from 225,000 lb to 650,000 lb capacity. Nearly all of the larger units are of the same general design as the unit illustrated at the right.

PRESSURES

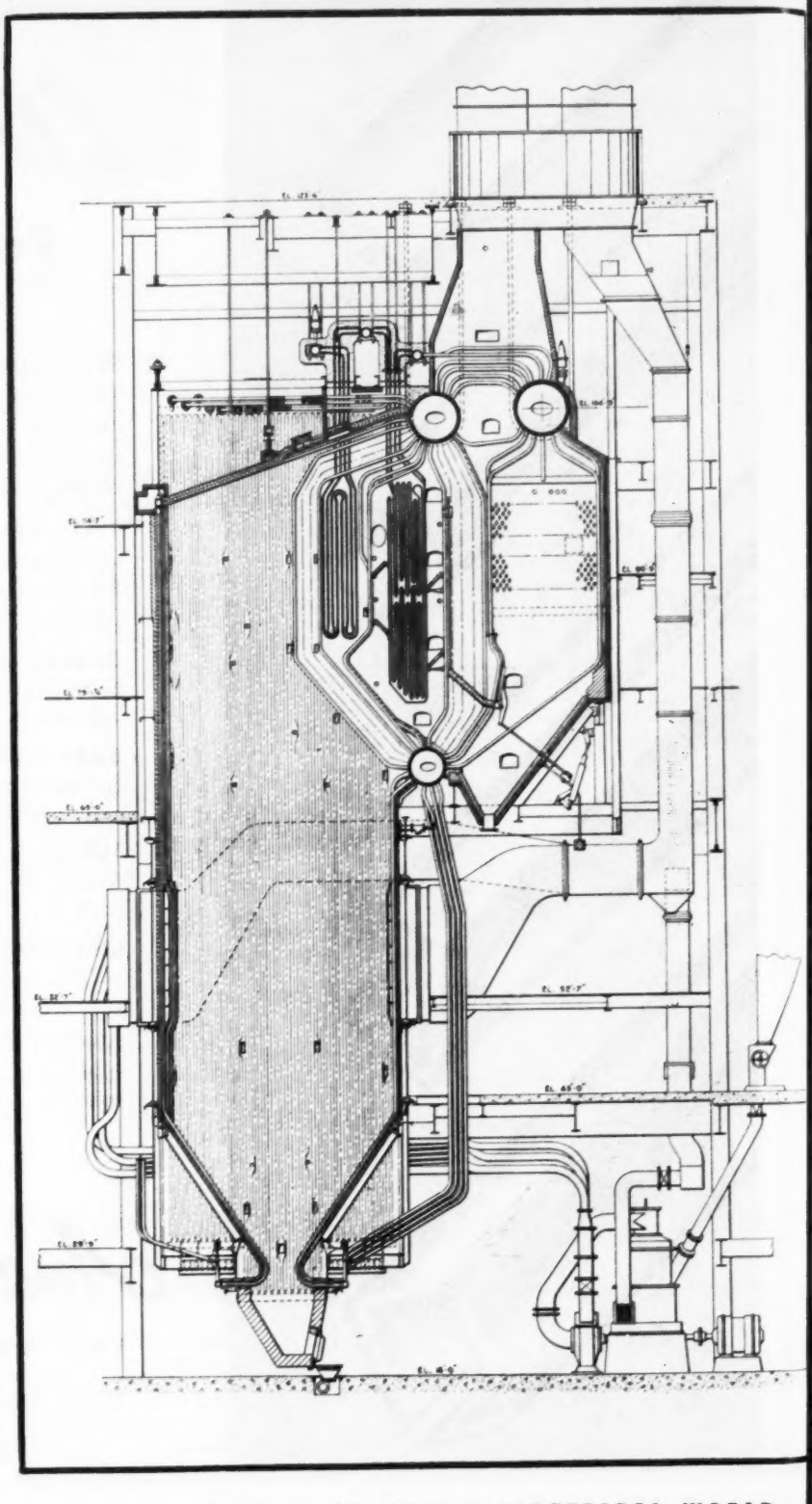
Design pressures range as high as 1525 psi. More than a third of the units have design pressures above 900 psi while five of them are for 1400 psi or higher.

TEMPERATURES

Total steam temperatures, except in the case of three relatively low pressure units, range from 750 to 925 F.

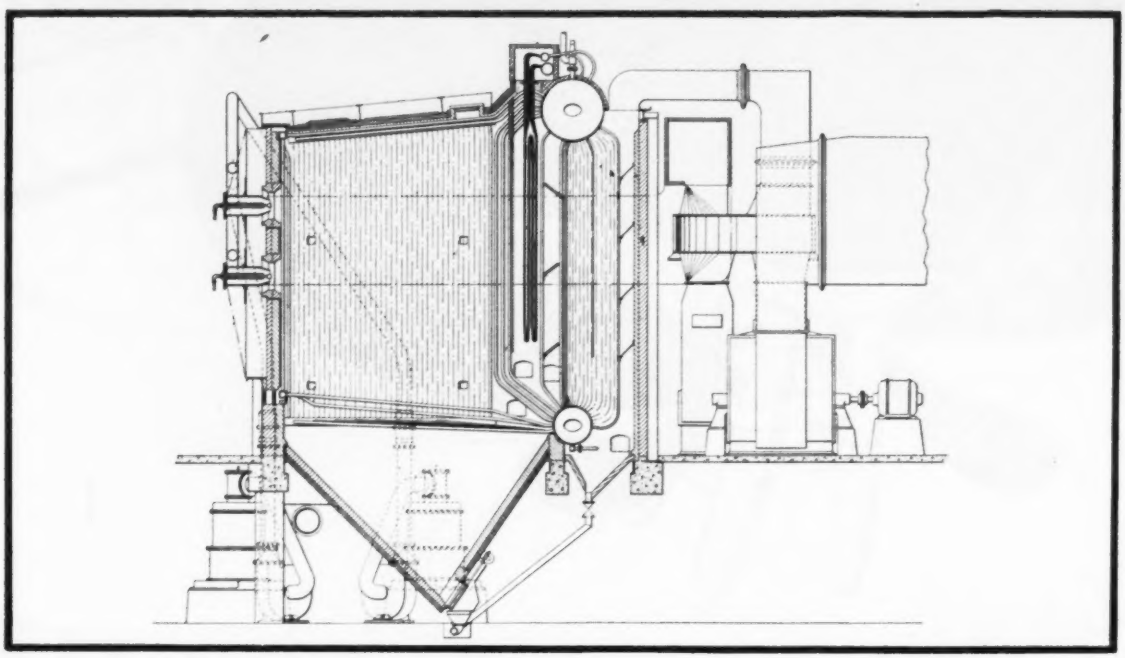
FUELS

All but two of the units above 200,000 lb capacity are pulverized coal fired using tangential burners; one unit is arranged to use oil as an alternate fuel. The VU units are about equally divided between those using coal and those for gas and oil firing; several are stoker fired.



GENERATING CAPACITY for Utilities

.....represented by C-E Units ordered, placed in service, or under construction in 1944



The two units here illustrated are generally typical of the C-E designs represented in 1944 work for utilities.

All of the larger C-E units in the group – those above 400,000 lb capacity – are of the type shown on the opposite page. Some have boiler surface instead of economizer surface in the last pass. All of the units above 200,000 lb capacity are pulverized fuel fired and all but two of these use tangential burners.

It is significant that all of the above mentioned units represent repeat orders. Their purchasers knew from past experience the performance they could count upon.

The Type VU Steam Generator shown above is generally representative of the smaller sizes of units. 1944 orders included several stoker fired VU units. Two of these, fired by very large C-E Chain Grate Stokers, are for 200,000 lb capacity. Several gas and oil fired units are included in the VU group.

While the aggregate capacity of these C-E units is considerably less than the total of Combustion Engineering's work for utilities in other recent years, it is a very substantial part of all the new steam generating capacity in the utility picture for 1944. A-852

COMBUSTION ENGINEERING

200 MADISON AVENUE NEW YORK 16, N. Y.

C-E

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

PLANNING POSTWAR POWER?

Two steam power plants are seldom the same. Usually, each has its special set of requirements and operating conditions. These will govern the equipment selected. But there *are* certain *basic* principles, common to all, governing the *type* of equipment. They've been evolved through experience—and tested in use.

Whether you're building a new plant or expanding an old one, these principles will serve as a valuable guide for your functional planning. Westinghouse, builder of the majority of products in a modern power plant, is well qualified and ready to place this information at your disposal.

Westinghouse

PART ONE

GETTING STARTED

Types of Turbines

Sizes of Turbines

Turbine Speeds

PART TWO

PERFORMANCE DATA

Basic Operating Conditions

Deviations in Operating Conditions

Approximate Over-All Dimensions

Recommended Condenser Sizes

Choice of Condenser Size

Condenser Data Charts

Condenser Dimensions

Condenser Friction

Circulating Pumps

Condensate Pumps

Other Auxiliaries

THEN YOU NEED THIS BOOK

This new Westinghouse Steam Power Plant Planning Guide contains basic information about condensing-type turbines from 10,000 kw to 60,000 kw . . . and the condensers suitable for them. Using this Planning Guide, you'll be able to trace the functional plan of your plant.

For a copy of this valuable new planning book, call your nearest Westinghouse Office. No obligation, of course. Westinghouse Electric & Manufacturing Company, Box 868, Pittsburgh 30, Penna.

J-50457

Steam Headquarters

STATOR

Coils are form wound, diamond shaped interchangeable and carefully insulated with selected materials. Core is built of accurately punched mill varnished, motor special, electrical sheet steel.

ROTOR

Rotor is of all welded construction. The core is built of electrical sheet steel punchings having partially closed slots. The winding is made from hard drawn copper strip driven into the slots. The ends of the rotor bars are welded to copper or alloy end rings. These rotor bars also provide fan action for efficient ventilation.

LIFTING LOOP

All sizes have large lifting loop to accommodate crane hook for easy handling.

BRACKET & BEARING

Bracket is cast iron, simple design, providing rugged bearing support with ample lubrication and a minimum of parts and machined fits.

VENTILATION

Cooling air, circulated by rotor bar fan is taken in through bracket openings and discharged at the center frame opening.

FRAME

Constructed of rolled steel rings with heavy cross ribs, angle type web feet and electrically welded.

SHAFTS

Shafts are large and well proportioned of 30-40 carbon steel.

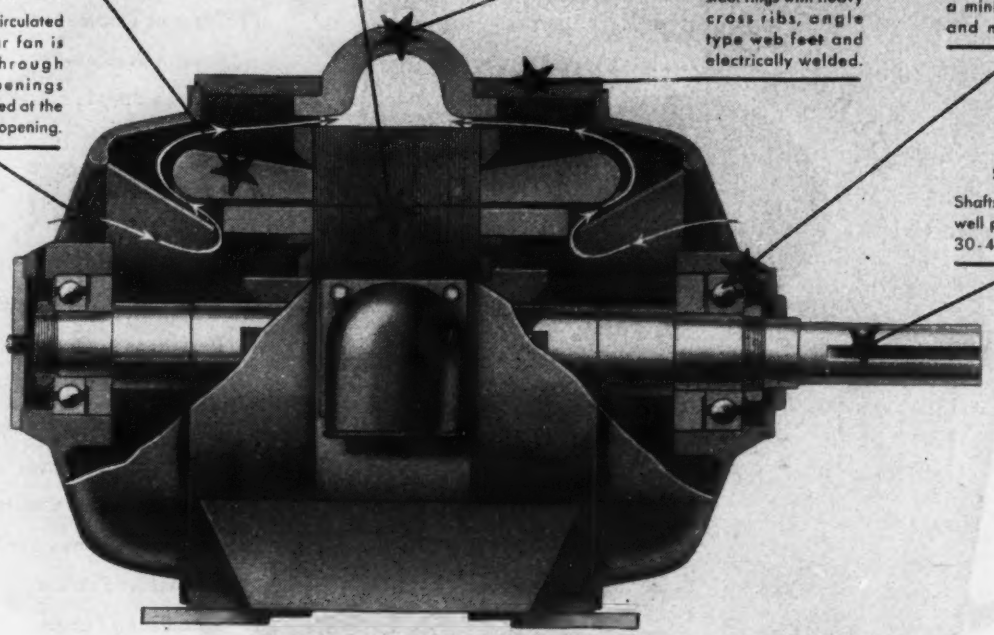
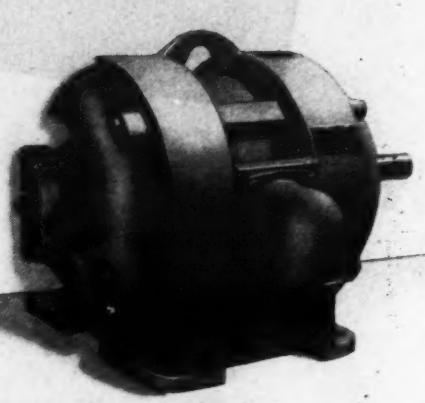


Illustration shows cross section view of Burke Type N 50 h. p. Induction Motor

BURKE *Induction* MOTORS

1 to 1500 h. p.



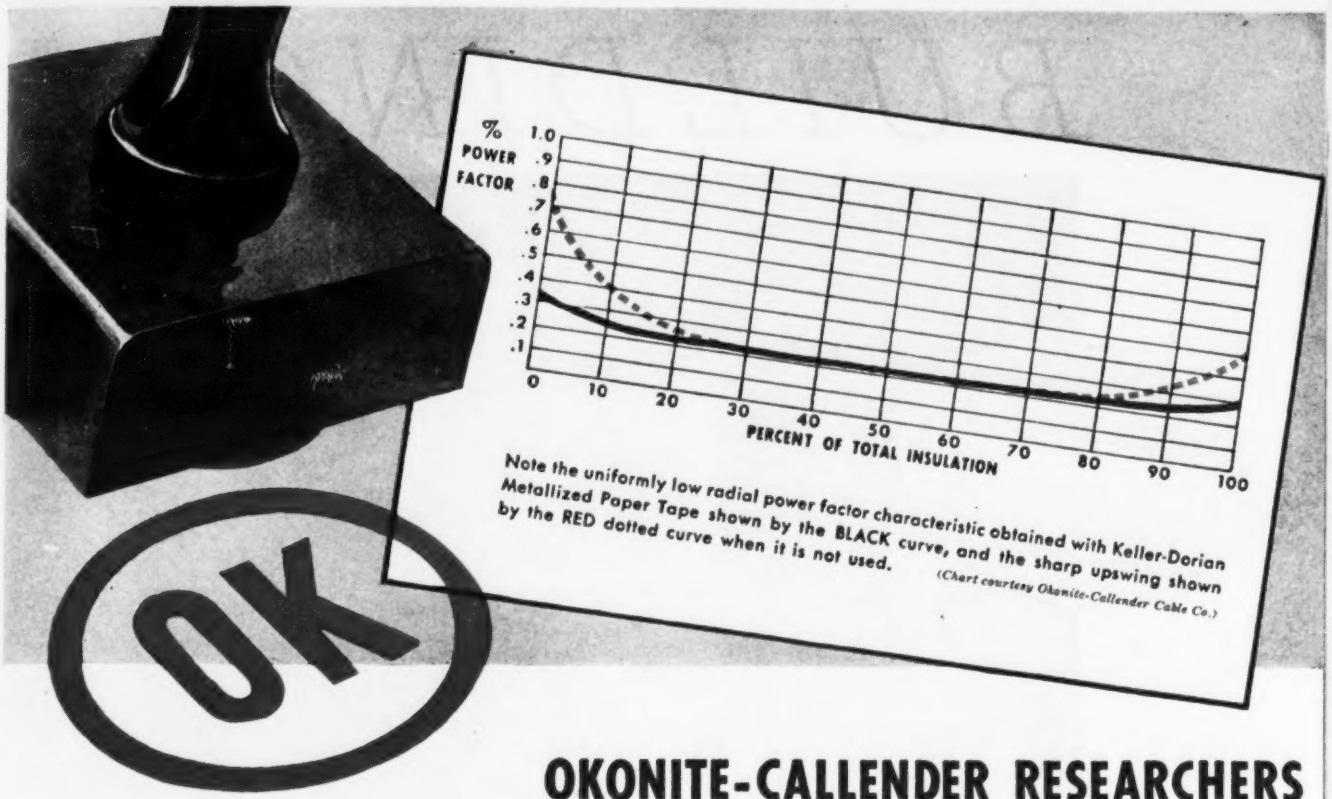
BURKE is a quality motor builder producing a standard line of motors but also able to meet exacting specifications of special applications. Burke Induction Motors are built in sizes from 1 to 1500 h. p. in all types, open and enclosed, both squirrel cage and wound rotor. Let Burke build for you. Send your specifications to Burke engineers today. Write for Bulletin 101 describing Burke Induction Motors.

SYNCHRONOUS MOTORS AND GENERATORS | **INDUCTION MOTORS** | **D. C. MOTORS** | **D. C. GENERATORS** | **M. G. SETS** | **HIGH SPEED A. C. GENERATORS**

MOTORS 1 TO 1500 H. P. · GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA · *Since 1891*



Note the uniformly low radial power factor characteristic obtained with Keller-Dorian Metallized Paper Tape shown by the BLACK curve, and the sharp upswing shown by the RED dotted curve when it is not used. *(Chart courtesy Okonite-Callender Cable Co.)*

OK

OKONITE-CALLENDER RESEARCHERS STAMP "O.K." ON KELLER-DORIAN METALLIZED PAPER TAPE

...for use in Paper Insulated Cables

From Okonite-Callender research laboratories came the answer to *"deterioration in oil-impregnated paper insulated cables":*

Keller-Dorian Metallized Paper Tape!

The metallized paper tape establishes a barrier between oil in the paper insulation and the conductor metal, effectively preventing destructive chemical reactions.

It's as simple as that.

And from Okonite-Callender's famed laboratories came these facts, too:

Keller-Dorian Metallized Paper Tape offers a smooth base on which to wind insulating tape and reduces concentrated stress points on strand surfaces. As an electrostatic shield, between insulation and outer sheath, it eliminates corona.

For a lower power factor . . . higher dielectric strength . . . greater break-down values . . . increased factor of safety and less deterioration due to the absence of excessive ionization . . . specify electrical wires and cables *"Engineered with Keller-Dorian Metallized Paper Tape"*. Keller-Dorian Corporation, Empire State Building, New York 1, N.Y.

HONOR ROLL OF
WIRE & CABLE MANUFACTURERS
NOW USING
K-D METALLIZED PAPER TAPE

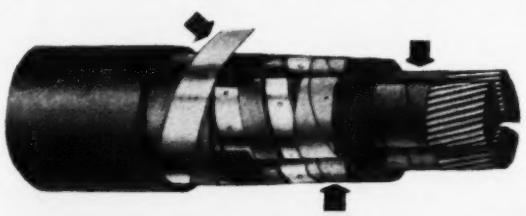
General Cable Corp.

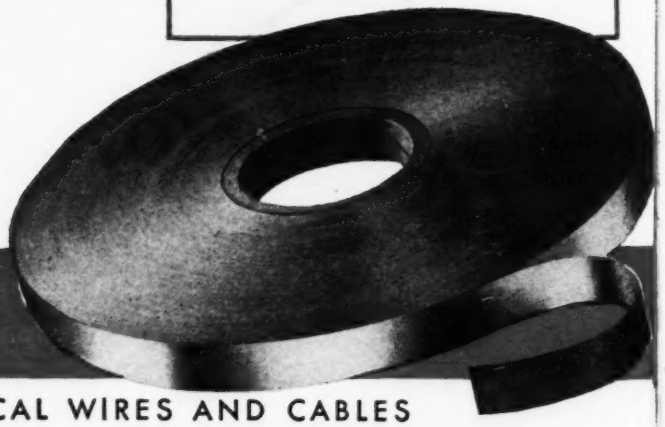
General Electric Co.

Okonite-Callender Cable Co.

Simplex Wire & Cable Co.

U. S. Rubber Co.





KELLER-DORIAN
CORPORATION

METALLIZED PAPER TAPE FOR ELECTRICAL WIRES AND CABLES

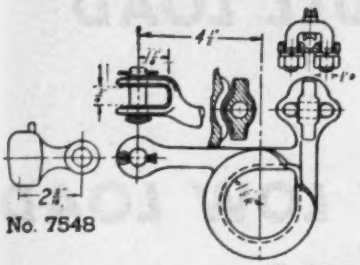
BUILDING A

BTC

The use of forged steel results in light weight with more than adequate strength. Low in price, this hardware is especially adapted to rural electrification.

THE BREWER-TITCHENER CORPORATION

RURAL LINE?



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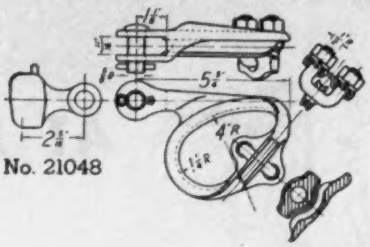

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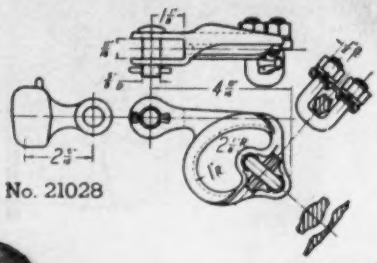

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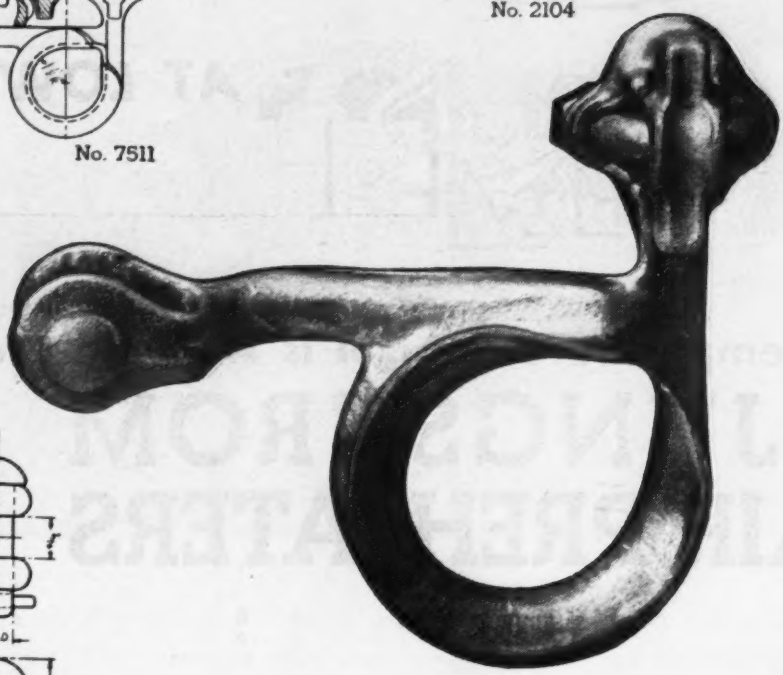

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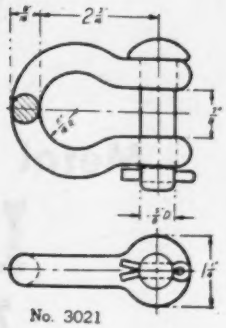

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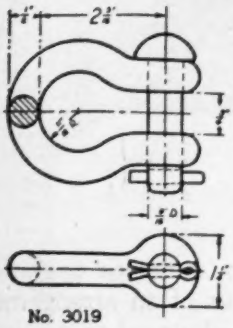

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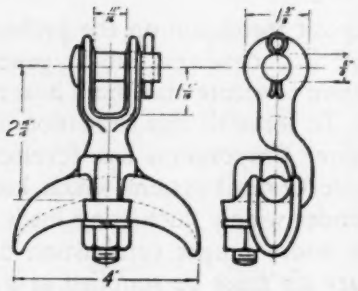

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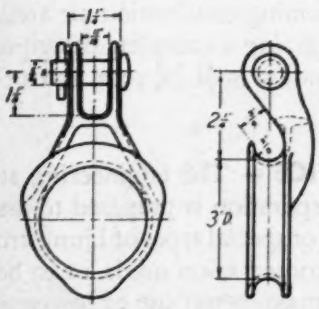

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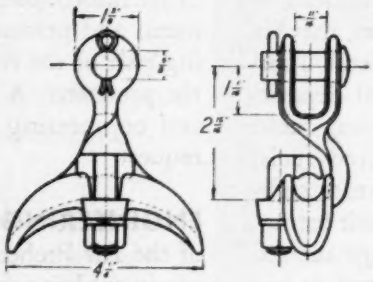

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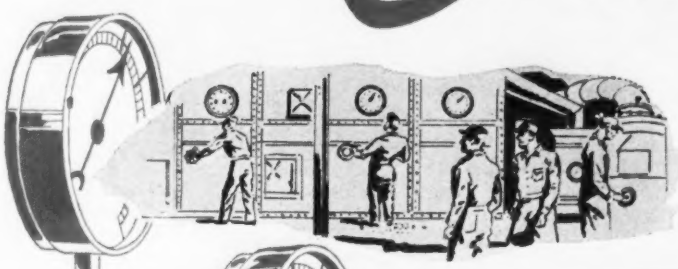
DROP FORGED HI-LINE HARDWARE

Through Your Insulator Manufacturer Only

BTC

CORTLAND, NEW YORK

FOR PREHEAT *Continuity*



AT FULL LOAD

AT LOW LOAD

Metal Temperature Control is Available for

LJUNGSTROM AIR PREHEATERS

• Deposit formation on the preheater heat-exchange surface is a condition which generally accompanies operation to secure maximum heat recovery under low loads. To forestall this formation of deposits, the Air Preheater Corporation has developed a Metal Temperature Control system which keeps metal deposit-free under widely fluctuating loads and varying fuels.

To insure proper combustion of powdered fuels, primary air must be supplied at a temperature sufficient to dehydrate the fuel. To prevent deposit formation, metal temperature of the heat exchange surface must be kept above the dew-point. The Ljungstrom system of metal temperature control maintains necessary temperatures at these two critical points. It is readily installed on any Ljungstrom Preheater, and is available for either manual or fully automatic operation.

Essentially the system consists of an arrangement of thermocouples and dampers, designed to maintain metal and primary air temperatures, through bypassing part of the cold, incoming combustion air around the preheater. A folder giving a complete description and engineering information will be sent you upon request.

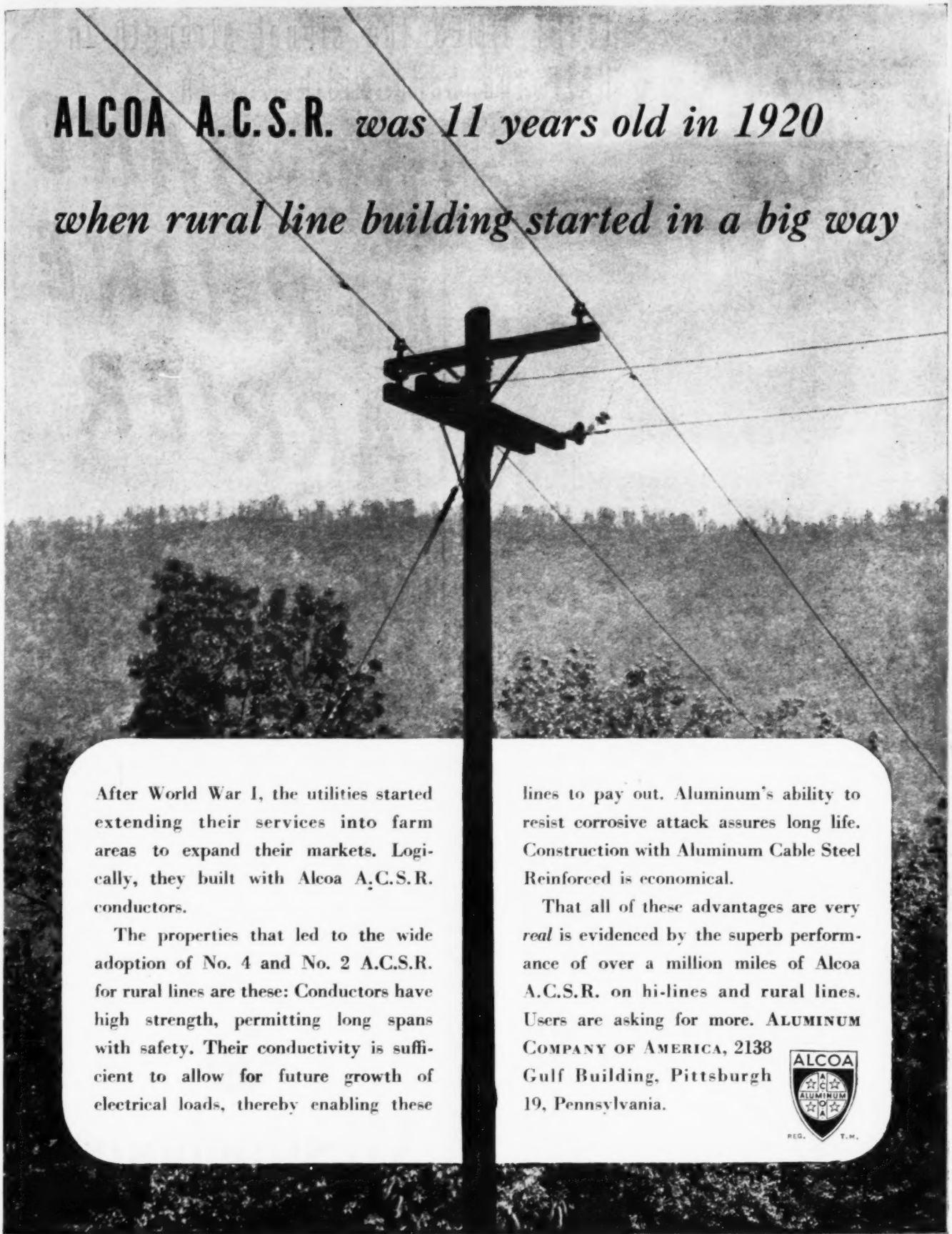
ENGINEERING SERVICE — The engineering staff of the Air Preheater Corporation is prepared to assist you in applying standard or special types of Ljungstrom Preheaters to your fuel conservation needs, or to help you and your engineers make better use of low-grade, more abundant fuels.

THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, New York



ALCOA A.C.S.R. *was 11 years old in 1920*

when rural line building started in a big way

After World War I, the utilities started extending their services into farm areas to expand their markets. Logically, they built with Alcoa A.C.S.R. conductors.

The properties that led to the wide adoption of No. 4 and No. 2 A.C.S.R. for rural lines are these: Conductors have high strength, permitting long spans with safety. Their conductivity is sufficient to allow for future growth of electrical loads, thereby enabling these lines to pay out. Aluminum's ability to resist corrosive attack assures long life. Construction with Aluminum Cable Steel Reinforced is economical.

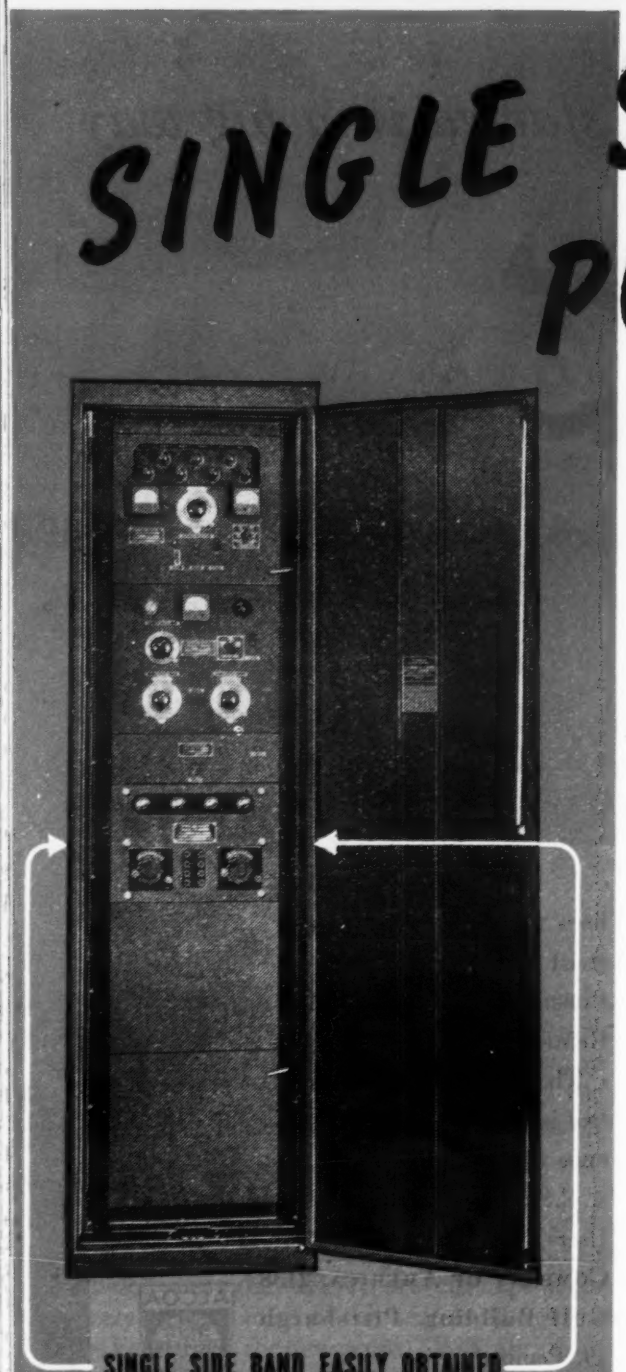
That all of these advantages are very *real* is evidenced by the superb performance of over a million miles of Alcoa A.C.S.R. on hi-lines and rural lines. Users are asking for more. ALUMINUM COMPANY OF AMERICA, 2138 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA A-C-S-R

ALUMINUM CABLE STEEL REINFORCED

NOW... EIGHT TIMES the signal strength in HALF the band width...with

SINGLE SIDE BAND POWER-LINE CARRIER



SINGLE SIDE BAND EASILY OBTAINED

Existing Westinghouse Type JY amplitude-modulated equipment can be converted to Single Side Band transmission by addition of a standard panel to transmitters and receivers. Where present needs can be met by installing Type JY (AM) equipment, Single Side Band conversion equipment can be added at any time as narrower channels and better signal-to-noise ratio are required.

Now available for the first time in practical, simplified form—Single Side Band Power-Line Carrier:

DOUBLES the number of channels available for carrier use. This is the answer to the ever-increasing problem of carrier-spectrum crowding which many users are experiencing.

PROVIDES higher signal-to-noise ratio than any other system occupying double the channel width.

ELIMINATES carrier heterodynes and corona modulation of carrier.

Single Side Band has its principal applications in communication, telemetering, and load control, and for a combination of these functions. It is particularly advantageous where transmission is over long distances and where noise and interference conditions are bad.

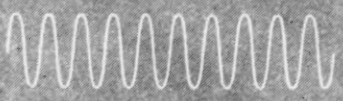
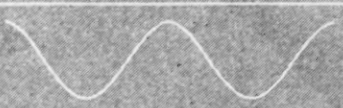
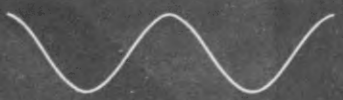
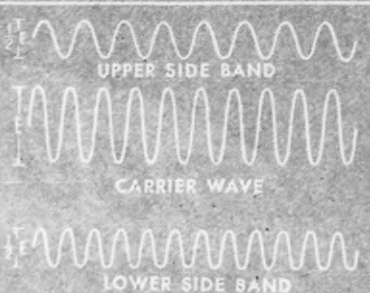
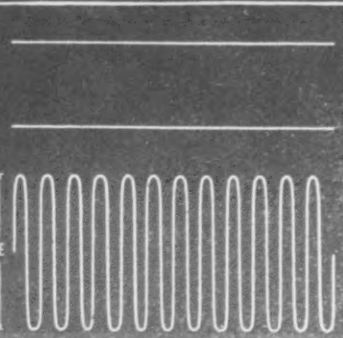
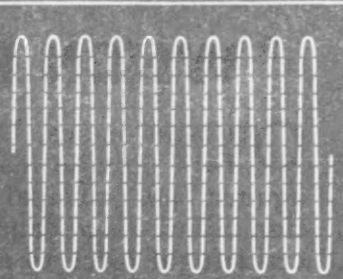
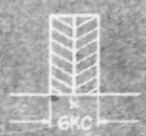
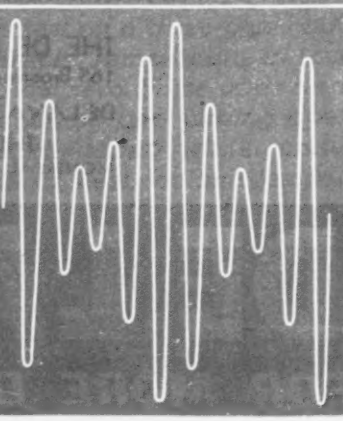
J-97090

Westinghouse

CARRIER

ENGINEERED . . . BUILT . . . TESTED TO *MATCH* POWER-LINE STANDARDS

HOW THE SYSTEM OPERATES

	AMPLITUDE MODULATION SYSTEM	SINGLE SIDE BAND SYSTEM
1. TRANSMITTED SIGNAL— ***no modulation present*** Carrier wave present in AM system—no signal at all in Single Side Band.		
2. AUDIO OR MODULATING WAVE Intelligence to be transmitted.		
3. COMPONENTS OF TRANSMITTED SIGNAL— ***modulation present*** One side band only is transmitted in Single Side Band system, with amplitude equal to total amplitude of carrier and both side bands in AM system.		
4. LOCALLY GENERATED CARRIER WAVE In Single Side Band system, carrier wave is generated at receiving end—not transmitted. As a result, very low power is required to produce equivalent of carrier wave received from other end in the AM system.		
5. BAND WIDTH REQUIRED Single Side Band signals occupy half the band taken by AM. Reducing receiver band width eliminates half the accepted noise power.		
6. RESULTING SIGNAL RECEIVED Sum of incoming side band and locally generated carrier produces a signal in the Single Side Band system equivalent to the AM signal—but with four times the power variations and half the noise, the equivalent of increasing the AM carrier power 8 times.		

OFFICIAL U. S. NAVY PHOTO

*WHEN PURIFIERS ARE DE LAVALS

ON land or sea, De Laval Oil Purifiers provide maximum protection against *both* principal sources of lubrication failure—*water* and *dirt*. They utilize centrifugal force to instantaneously remove these *two* trouble-makers from the oil and thus constantly maintain its lubricating efficiency. By keeping the oil continuously and unfailingly clean and dry, they enable it to perform with "new oil" efficiency and safety over exceptionally long periods of time.

Whether the power unit is a Diesel engine requiring only a De Laval centrifugal Oil Purifier, or a turbine where use of the De Laval-Funk Process—the ultimate in turbine oil protection—is indicated, there is no more practical, efficient means of guarding it against lubricating oil trouble than by means of a De Laval centrifugal Oil Purifier operating on continuous by-pass. This will insure that the oil is freed of impurities and water three or four times daily.

•Write for complete information, sent without obligation.

THE DE LAVAL SEPARATOR COMPANY
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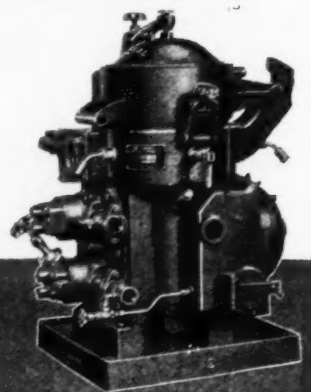
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER



DE LAVAL OIL PURIFIERS

FOR MORE DEPENDABLE POWER PRODUCTION

BUY AND KEEP WAR BONDS FOR FUTURE SECURITY

THE BEST ICE TESTS ARE MADE IN NATURE'S OWN LABORATORY

THERE IS NO SUBSTITUTE FOR NATURAL SLEET AND ICE COMBINED WITH OXIDATION FROM EXPOSURE TO CONTAMINATED ATMOSPHERE. TESTS MADE UNDER THESE CONDITIONS PROVE WHAT THE SWITCH WILL DO IN ACTUAL SERVICE.

To prove the ice breaking features of Delta-Star outdoor switches, ice tests are always made on complete three-pole units with standard mechanisms under conditions closely simulating actual service conditions.

Switch units under test are mounted on outdoor test racks during the summer months and exposed to the elements the same as switches in actual service. During cold weather, periodic operational tests are made after ice, sleet and snow have accumulated. Optional tests are also made by spraying the units to increase accumulation of ice to the desired extent.

FOR FURTHER TEST INFORMATION CALL OUR NEAREST DISTRICT OFFICE

Illustration shows test on a three-pole 1,200 ampere, 161 kv switch. Temperature at time of test was 12° below zero. Same units were tested for both opening and closing operations several times during winter under various conditions of sleet, ice and temperature.

DELTA-STAR ELECTRIC COMPANY

MAIN OFFICE AND FACTORY — 2400 Block, Fulton St., Chicago 12, Ill.
NEW YORK OFFICE — 140 Cedar St., New York 6, N. Y.

DISTRICT REPRESENTATIVES IN THE FOLLOWING CITIES

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Charlotte, N.C.	Los Angeles, Cal.	St. Louis, Mo.
Cleveland, Ohio	Minneapolis, Minn.	San Francisco, Cal.
Dallas, Texas	New Orleans, La.	Seattle, Wash.
Detroit, Mich.	Norfolk, Va.	Washington, D. C.
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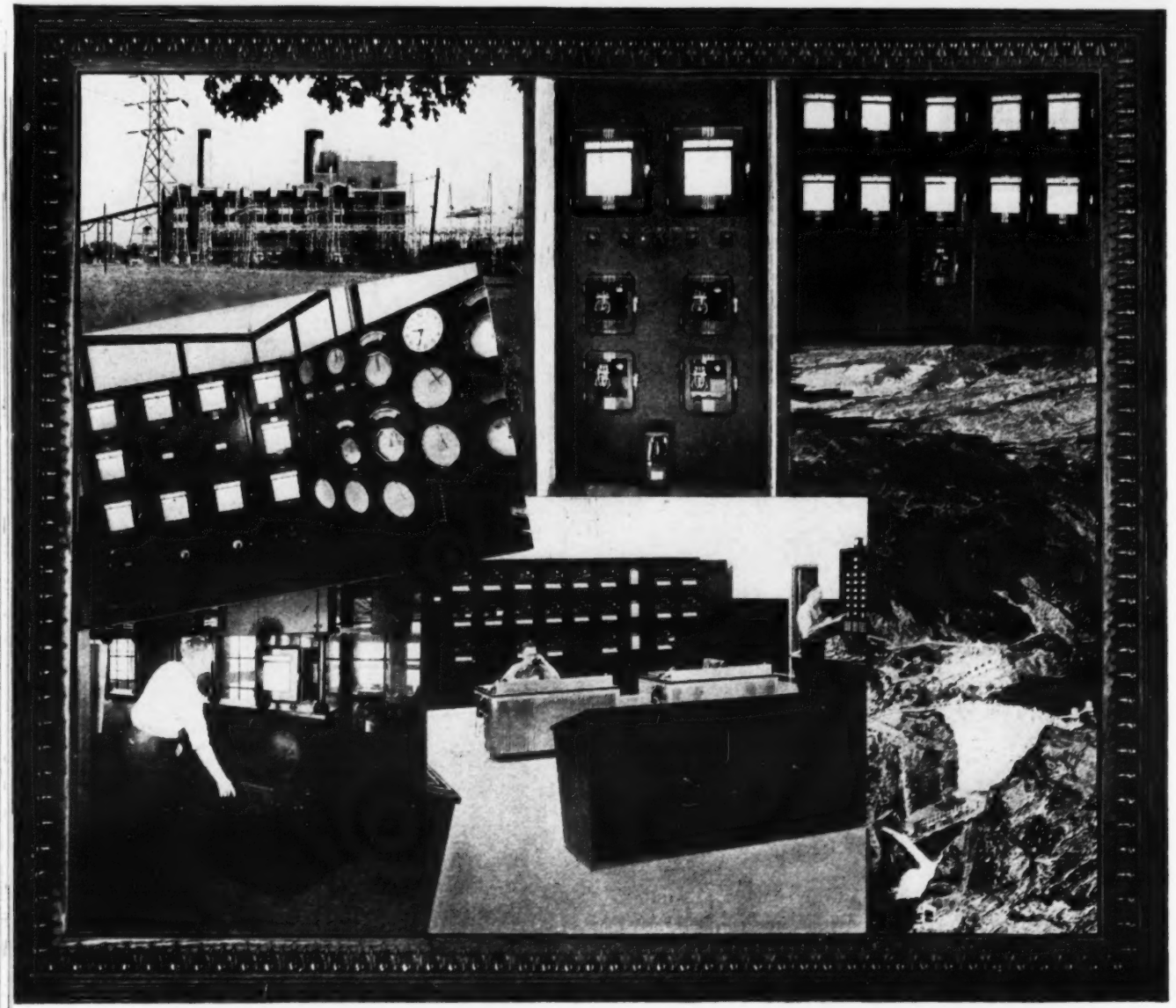
CANADIAN ASSOCIATE

Canadian Line Materials Limited ..... Toronto 13, Canada



A few L&N Load-Frequency Control panels, and two of the many stations which use this equipment to regulate most of America's interconnected load

THE LOAD-CONTROL PICTURE ~~CAN~~ *will* CHANGE!

Helping to make the best use of a power interconnection—that's the job of L&N Load-Frequency Controllers. It's a task which changes, with time, on most networks. Today the problem may be to increase the amount of power on a tie, by preventing surges so that the average transfer is increased. . . Tomorrow, this same accurate control may help to rush power into an area which has lost a generator by some accident. . .

And, day after tomorrow, the L&N Controllers may be helping provide power at minimum cost. The accuracy of these instruments will be a great help when a cost differential of perhaps half a mill per kwhr will decide which stations are to operate, and at what load. L&N equipments will operate every unit just as directed—help shave the ultimate fraction from costs.

L&N Load-Frequency Control is outlined in our Technical Publication N-56-61(1) free on request.

Here are the types of L&N Load-Frequency Control you can employ to meet changing power situations:

Economic Load Control.
Tie Line Load Control.
Flat Frequency Control.
Telemetering, Recording, Totalizing of Load.
Recording of Frequency.

LEEDS & NORTHRUP COMPANY, 4938 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS • TELEMETERS • AUTOMATIC CONTROLS • HEAT-TREATING FURNACES

Ad N-56-161(5)

depends on me!
A Slogan For Every American

FWD

TRUCK POWER

Helps Solve Shortages of Man-Power

No public utility attempts to get by with alibis. Regardless of handicaps of manpower shortage, over-worked equipment and restricted materials, industry and the public have got to be given service when they need it. Even in emergencies beyond ability of man to forecast, there can be no condoning of service interruptions.

FWD truck-power is a vital factor in helping utilities meet today's unprecedented demands. Old FWD trucks that have had long years of punishing service are proving that they still can "take it", in any weather, over any roads, or "off the beaten path", if necessary . . . because their ruggedness, power and traction in all four wheels, and natural all-'round adaptability to utility service go far beyond the limits of normal duty!

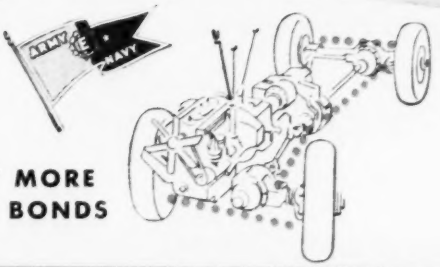
Big fleets of FWDs in service of over 150 utilities from coast to coast, have been proving for the past 30 years that they need no alibi in "following the job", regardless of location.

THE FOUR WHEEL DRIVE AUTO CO., Clintonville, Wis. *Canadian Factory: Kitchener, Ontario*

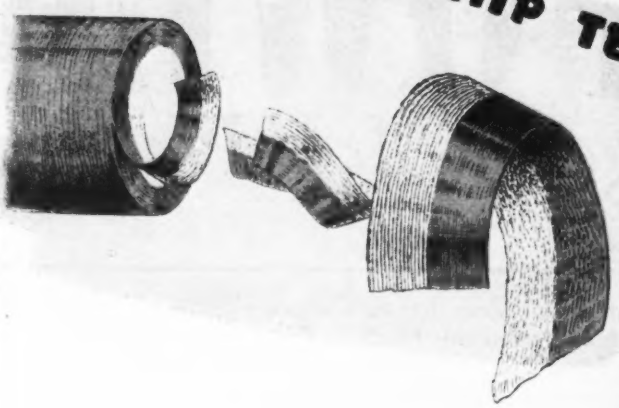
One of Wisconsin Telephone Company's FWD Utility Trucks digs holes, sets poles, Fast . . . Saving Much Man-Power.

FWD TRUCKS

BUY MORE WAR BONDS



• *Oldest and original exclusive builders of Four-Wheel-Drive Trucks—famous for power and savings in tires, gas, oil, replacements.*



THIS CHIP TELLS

THE STORY

OF THE WELD IN COPPERWELD

Lathe-turned from a section of a Copperweld billet, this chip clearly illustrates copper and high-strength alloy steel permanently united. The two metals are welded to each other and cannot be separated except by the destruction of the material itself. This permanent weld is achieved by the Copperweld process of molten welding.

By specifying Copperweld you are assured of the electrical and mechanical characteristics most vitally needed for dependable and economical service—the high conductivity and corrosion resistance of copper plus the rugged strength of steel.

Write for our Engineering Data Book

Copperweld

RODS, WIRE AND STRAND

COPPERWELD STEEL COMPANY

GLASSPORT PENNA.

Here's a "light package" to do a 2-way selling job . . . NOW

THERE'S DANGER IN DARKNESS BUT SAFETY IN LIGHT

Now is the time to start planning for adequate Public Safety Lighting : : : and Westinghouse is ready now with a new package of promotional helps to dramatize the need of improved street lighting to both the public and municipal executives.

This "light package" includes carefully-planned meeting guides for demonstrations before civic groups . . . sound slide films, charts, educational material, plus the services of Westinghouse Lighting Specialists.

Many utilities are now studying the problem of im proved Public Safety Lighting as a means of creatin public good will : : : an important contribution t solving community hazards of accident fatalities an juvenile delinquency.

Join the fight for better light : : : do it now. Writ your nearest Westinghouse office today, or writ Westinghouse Electric & Manufacturing Company P. O. 868, Pittsburgh 30, Pennsylvania. J-040

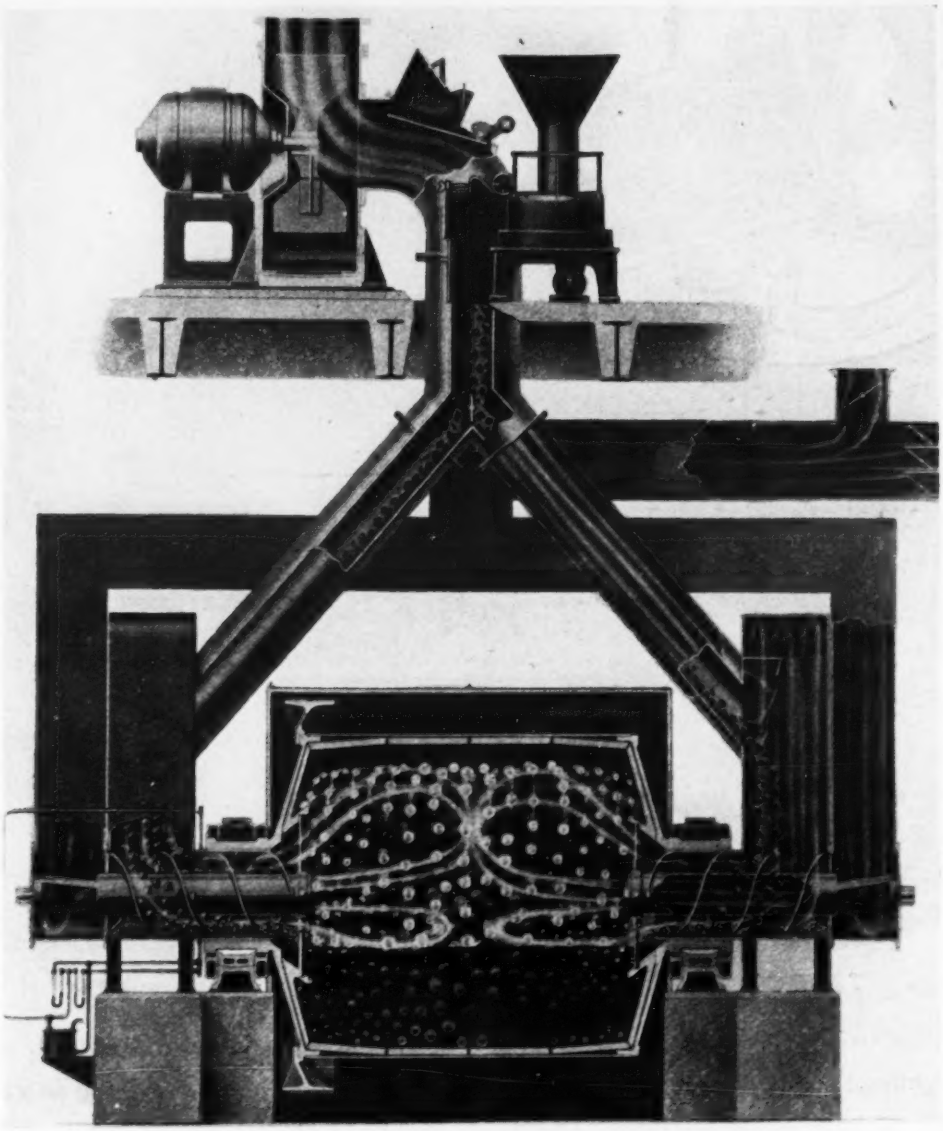
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

lighting division

PUBLIC SAFETY LIGHTING HEADQUARTERS

Continuous FINE GRINDING



Fine grinding and Full Capacity are obtained without dependence on close clearances between moving parts.

New Ball charge (the grinding medium) is added during operation as necessary, thus eliminating shut-downs to replace the pulverizing parts.

FW FOSTER

# of PULVERIZED FUEL GIVES HIGHER BOILER EFFICIENCY

The outstanding performance characteristic of Foster Wheeler (Hardinge type) Ball Pulverizers is maintenance of high fineness in the pulverized fuel—over long periods of service without loss in capacity.

This exceptional ability to operate without reduction in fineness or forced outage, effects material savings including:

1. Boiler efficiency maintained for duration of run with resultant low cost for fuel.

2. Boiler outages for cleaning heating surfaces reduced; pulverizer repairs minimized.

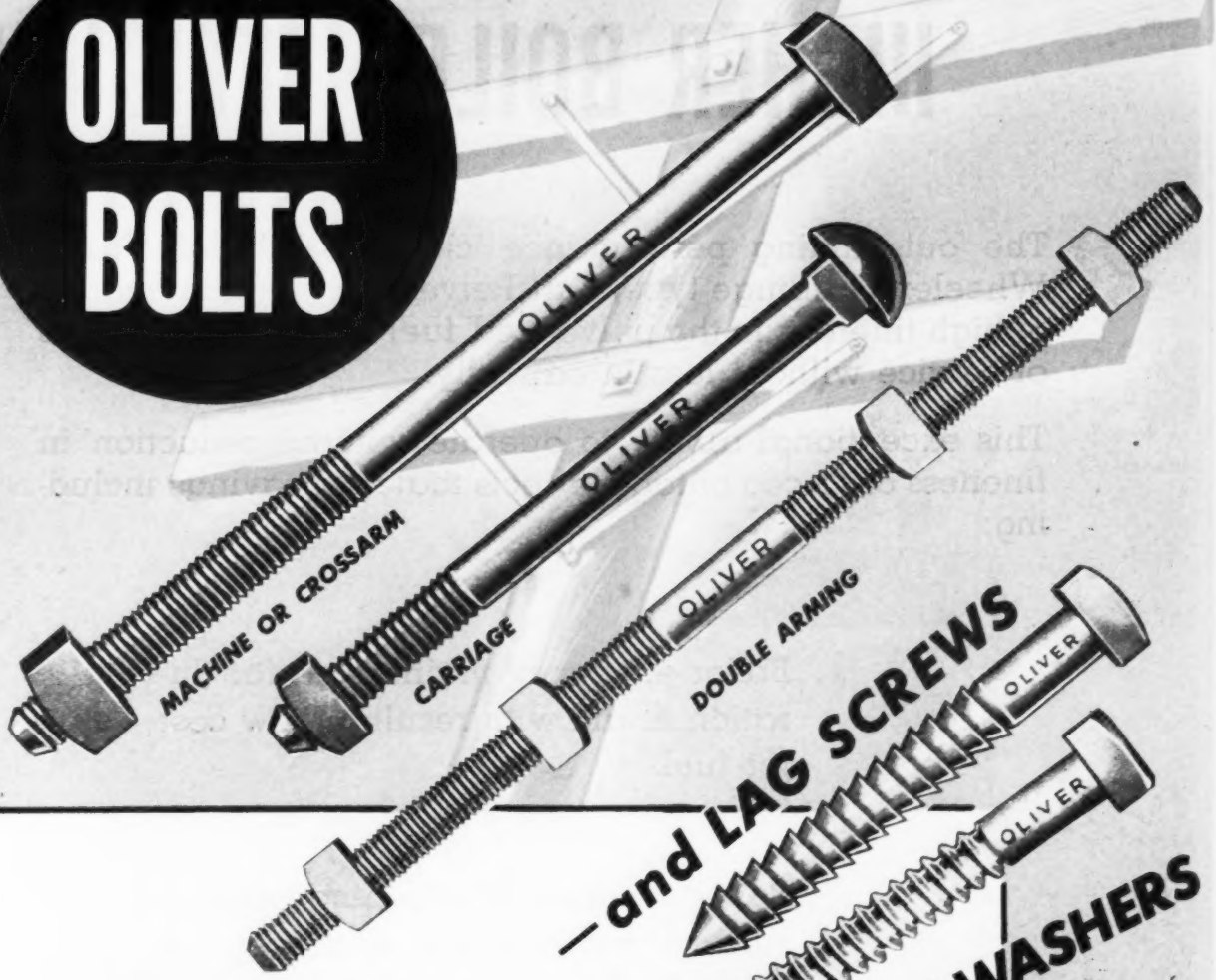
3. Labor charges against cleaning boiler and water wall surfaces sharply decreased.

FOSTER WHEELER CORPORATION, 165 Broadway, New York 6, N. Y.

WHEELER FW

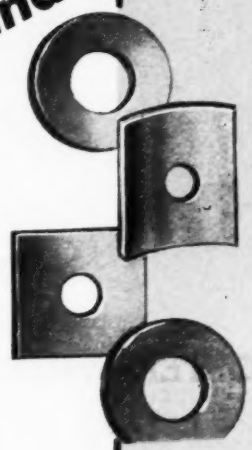
from the complete line of OLIVER POLE LINE MATERIALS...

OLIVER BOLTS



—and LAG SCREWS

—and WASHERS



Speed-pointed Oliver Bolts are made from new open-hearth steel. Heads are of proper size to develop full strength of bolts; threads are accurately rolled to uniform size and depth; galvanized coating is applied by a centrifugal process which removes excess spelter and insures free-running threads.

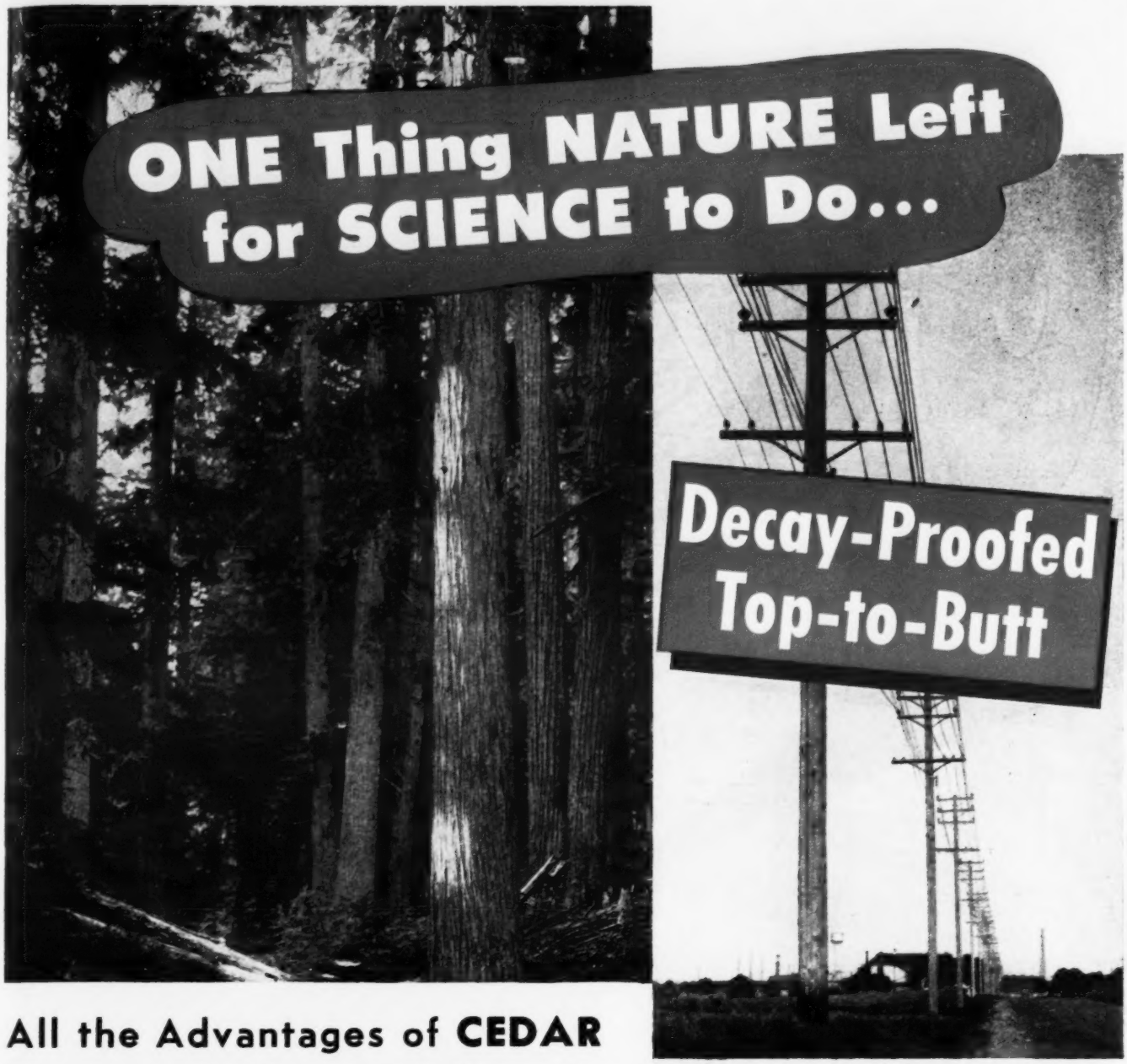
The Oliver line of bolts is complete in diameters and lengths. Lag Screws and Washers also available in popular sizes and styles.

The Oliver Speed Point makes threading-on of nuts faster, protects end threads when driving out for salvage.

OLIVER
IRON AND STEEL
CORPORATION

SOUTH TENTH AND MURIEL STREETS · PITTSBURGH 3, PENNA.

Makers of Pole Line Materials Since 1894



All the Advantages of CEDAR Plus Decay Resistance—Full Length

In cedar, Nature has created the ideal timber for pole use. Cedar is strong yet light, straight and sound, has low gravity center, high insulating value. Fine as cedar is, however, science has succeeded in adding an important extra that makes it even better—that preserves its many natural advantages for added years of service. Through a full-length pentachlorophenol treatment of the sapwood, in addition to the regular creosote butt treatment, Life Span Cedar poles have been given extra decay and termite immunity from top to butt and from outer surface to heartwood. In the long run Life Span cedar poles cost less and are worth more because they last longer!

LIFE-SPAN CEDAR POLES

Sold only by the following

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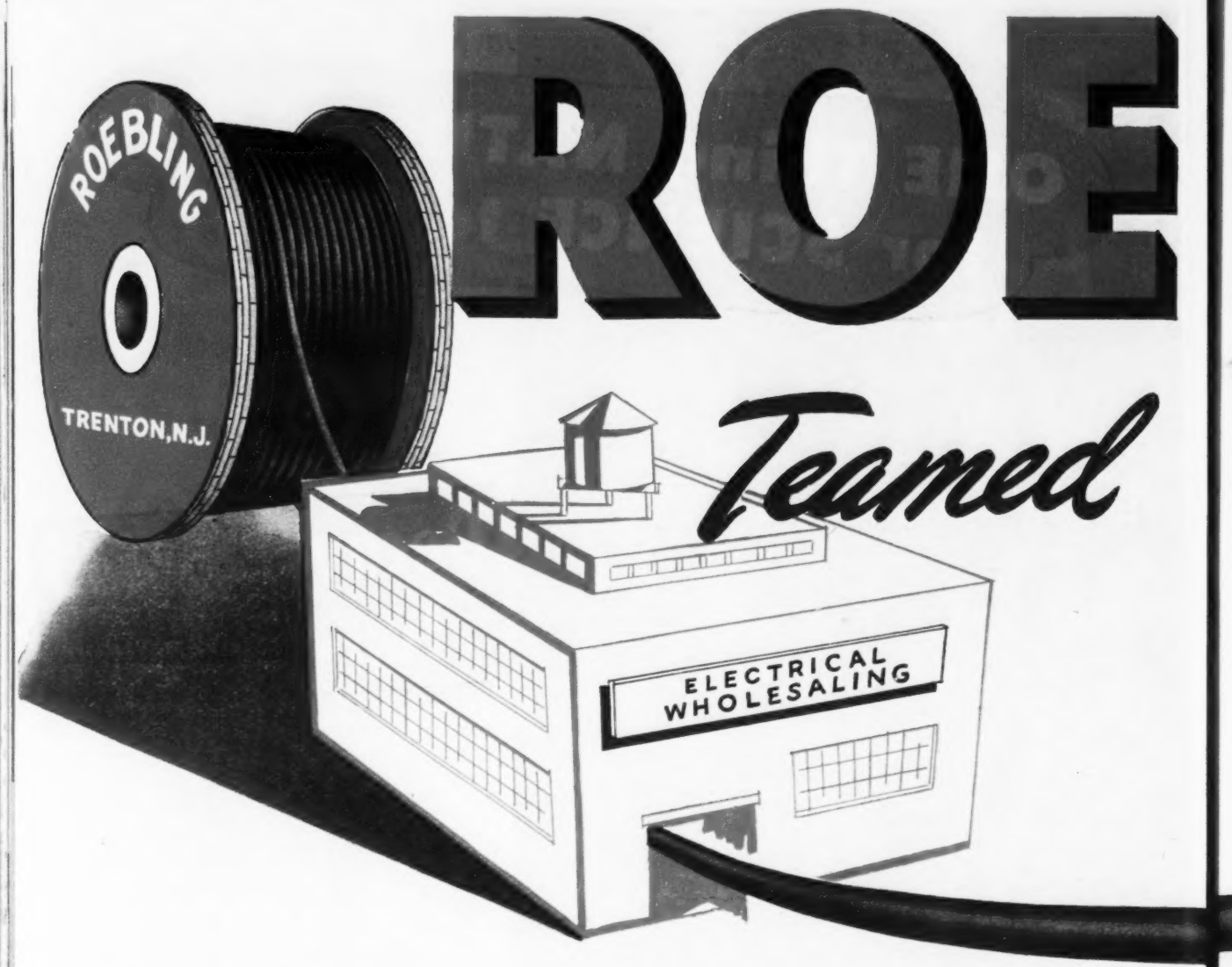

ROEBLING ELECTRICAL WIRES AND CABLES

WEATHERPROOF WIRE • RUBBER COVERED WIRES AND CABLES • SERVICE ENTRANCE CABLES INCLUDING THIN-WALL INSULATED BUILDING WIRES AND CABLES) • RUBBER SHEATHED PORTABLE CABLES • RUBBER INSULATED POWER CABLES • TELEPHONE WIRES • VARNISHED CAMBRIC POWER CABLES • MAGNET WIRE BARE COPPER STRAND • PIGTAIL AND BRAIDED COPPER • TROLLEY CONTACT WIRE

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for your Profit!

1. The finest in electrical wires and cables from **ROEBLING**

2. The best in service from **ROEBLING ELECTRICAL WHOLESALERS**

EVER STOP TO THINK that the best products in the world aren't very helpful unless you get them when and where you want them? And at the right price?

Thank your electrical wholesaler for *that* part of a job well done . . . even under the strain of total war, with increased demands and limited supplies.

That's why Roebling will continue to team up with electrical wholesalers now and always. We'll do our part of the job with a complete line of wire and cable that embodies every modern development and assures the best possible service. Roebling wholesalers will see that you get them, and hundreds of other fine electrical products too.

Roebling and your local wholesaler . . . it's a team that you can't beat when you want the best products and service. Teamed for *your* profit!

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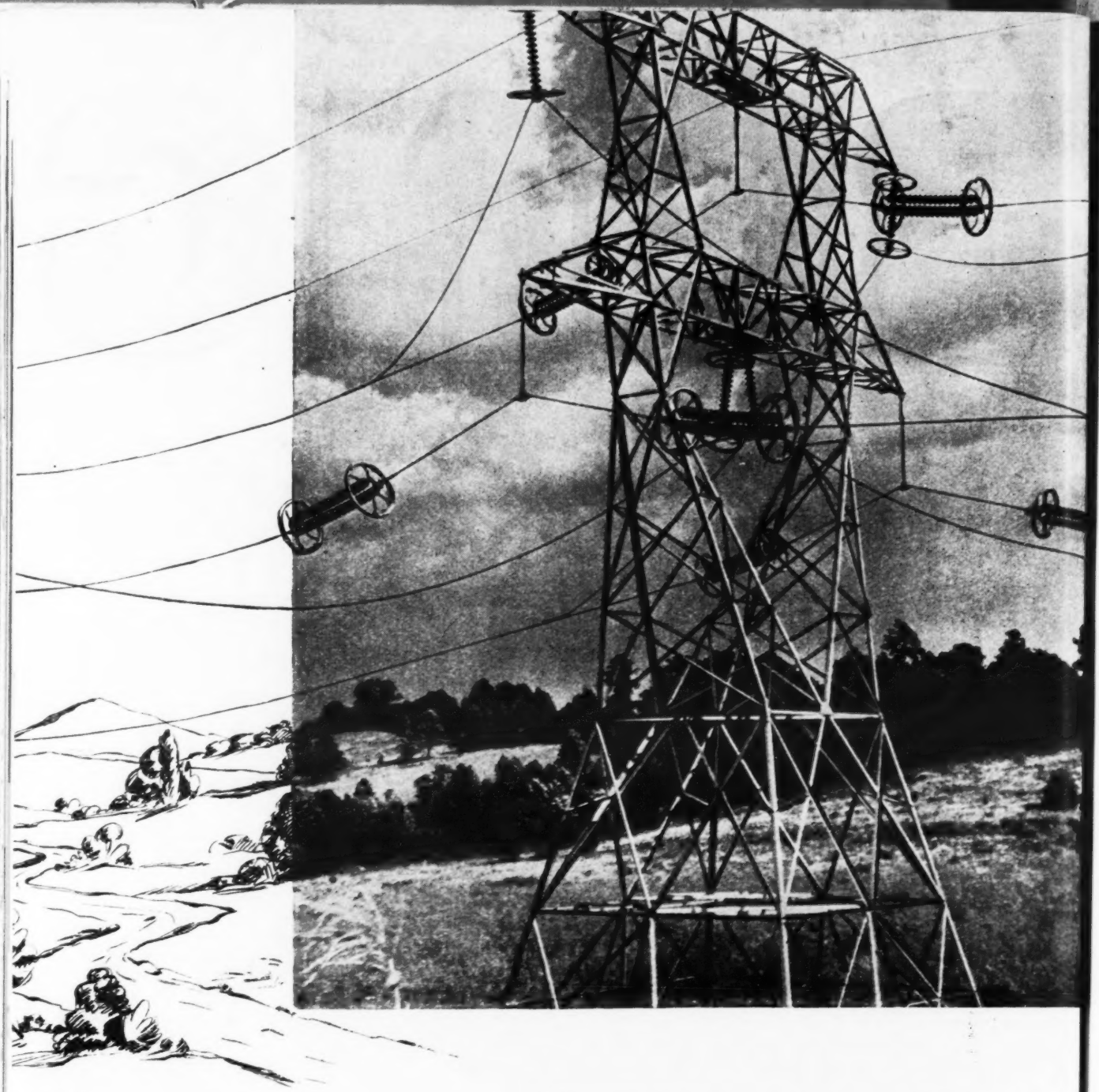
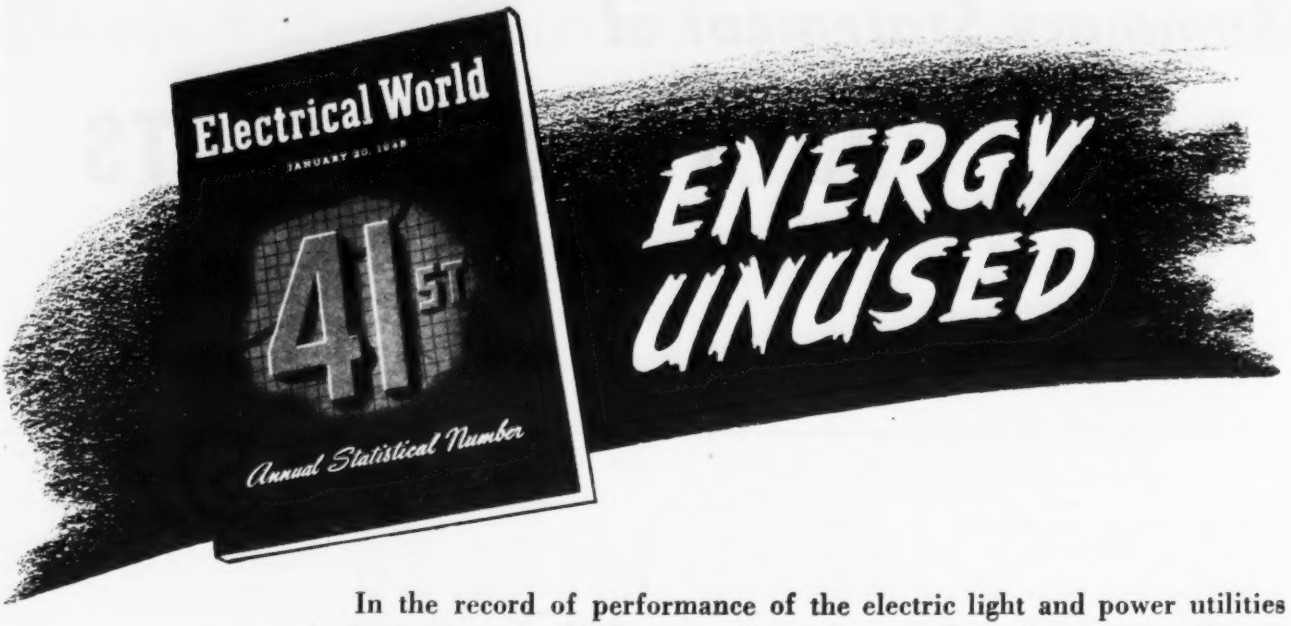


"Over the River and through the Woods..."

Kilowatts to power a factory or fry an egg are carried from source to millions of outlets on the broad shoulders of Blaw-Knox transmission towers . . . Utility engineers everywhere know that their specifications are "the law" with Blaw-Knox tower designers and fabricators.

BLAW-KNOX Division of Blaw-Knox Company
2013 Farmers Bank Building • Pittsburgh, Pennsylvania

BLAW-KNOX TRANSMISSION TOWERS



In the record of performance of the electric light and power utilities in 1944, there is told the story of much more than of just that industry. It is the story of the whole nation. And in the brutally sharp light of the closing weeks of the year, it is not a pretty story.

Output required from the electric utilities was greater in 1944 than in 1943, but not enough greater. Demands made on production capacity were higher. But not enough higher. The unit of capacity was called upon to produce more units of energy. But not enough more.

In the first week of 1944 production of electricity in the United States was 15.9 percent greater than in the same week the year before. In the last week of 1944, which was comparable with a corresponding week of 1943, production was 1.1 percent less. And the 1944 record had been below 1943 since early in October. This decline from a major plus to an actual minus encompasses the whole sorry tale of over-confidence, of under-estimation of the enemy, of governmental fumbling, of too-soon concern with post-war problems, of lack of restraint in clutching for advantage by groups and cliques and classes.

Except that it must bear its share of reproach for the national condition, the electricity supply industry is not to blame that its performance in 1944 was not better. If more had been demanded of it, more would have been supplied. There was more to be had if more had been required. The utilities can say that and it is true. The margin between power demand and capacity to supply it widened in 1944.

In time of war the utilities respond to, but do not create, the demands made upon them. Their responsibility is to be ready to respond, immediately and adequately. There was no failure in this responsibility in the year past.

1944 was the biggest year the electric utilities have ever had, biggest in output, sales, revenue, and utilization of production capacity. But it was not as big as it would have been if the nation had not slacked off. At the beginning of 1945 the light and power utilities say to the nation, "Give us more work to do."

Summary Statement of

OUTSTANDING FACTS

	1937	1938	1939	1940	1941	1942	1943	1944*
FIXED CAPITAL ($1,000,000)	12,940	.....	.....	.....	14,143	.....	.....	.....
Securities issued [1] ($1,000)	646,312	964,005	996,347	989,459	740,832	356,254	371,062	1,018,228
New capital	81,984	123,056	16,219	92,376	97,065	92,666	9,920	15,587
Refunding	563,699	840,949	980,128	897,083	643,767	263,588	361,141	1,002,641
REVENUE [2] ($1,000)								
From ult. consumers	2,160,798	2,156,580	2,289,583	2,440,218	2,665,057	2,885,843	3,077,643	3,250,000
Rural	37,726	38,928	45,484	49,473	64,396	75,027	76,617	81,000
Residential	759,824	802,532	843,158	895,951	938,229	990,185	1,029,260	1,087,000
Small light and power	616,438	632,091	660,683	689,253	725,117	767,279	776,228	810,000
Large power and light	583,197	518,694	572,659	631,428	758,083	828,318	961,642	1,031,000
Other consumers	163,611	164,334	167,597	173,752	179,233	195,034	233,996	245,000
EXPENDITURES ($1,000)								
Capital	455,480	482,000	430,000	596,580	654,148	522,200	305,904	340,284
Operating, total	1,027,588	.....	.....	.....	.....	.....	1,127,000	1,219,000
Salaries and wages	470,353	460,000	469,500	488,000	537,000	.....	377,000	376,000
PRIVATE COMPANIES ($1,000)								
Operating revenue	2,031,000	2,018,000	2,148,000	2,277,000	2,475,000	2,611,000	2,807,000	2,926,000
Operating expenses	781,000	762,000	798,000	863,000	950,000	1,011,000	1,117,000	1,219,000
Taxes	308,000	323,000	352,000	404,000	521,000	630,000	688,000	700,000
OUTPUT [3] (1,000,000 kw.-hr.)								
Generated	121,837	116,681	130,336	144,985	168,170	189,181	220,728	230,400
From steam	76,330	70,727	85,007	95,675	115,276	123,356	145,045	155,000
From water power	44,489	44,834	44,021	47,753	51,262	64,179	73,922	73,000
From internal combustion	1,018	1,120	1,307	1,557	1,632	1,646	1,761	1,900
CAPACITY [3] (1,000 kw.)								
Generator ratings	37,134	39,042	40,318	41,639	44,092	46,407	49,305	50,524
Steam	25,873	27,203	28,047	29,019	30,823	32,332	34,178	34,742
Hydro	10,576	11,066	11,415	11,675	12,264	13,025	14,067	14,719
Internal combustion	685	773	856	945	1,005	1,049	1,060	1,063
FUEL CONSUMPTION [3]								
Coal (1,000 short tons)	44,766	40,212	46,223	53,398	64,760	68,420	79,665	82,000
Oil (1,000 bbl.)	14,143	13,077	17,423	16,722	20,250	15,280	18,085	20,500
Gas (billion cu. ft.)	171	171	191	183	205	239	301	370
ENERGY SALES [3] (1,000,000 kw.-hr.)								
Ult. consumers	99,359	93,731	105,768	118,643	140,060	159,408	185,889	197,600
Rural	1,670	1,577	1,881	1,991	2,352	2,890	2,996	3,300
Residential	17,691	19,371	21,084	23,318	25,124	26,937	28,621	31,050
Small light and power	18,075	19,137	20,722	22,373	24,628	27,234	29,071	29,700
Large power and light	51,360	43,140	51,108	59,557	76,060	88,378	105,778	113,800
Other	10,562	10,505	10,972	11,405	11,896	13,968	19,423	19,750
CUSTOMERS [3] (1,000)								
Total number	27,262	28,064	29,105	30,191	31,607	32,210	32,396	33,030
Rural	519	526	634	686	987	1,096	1,088	1,150
Residential	22,372	23,112	23,965	24,952	26,025	26,620	26,872	27,360
Small light and power	4,072	4,127	4,215	4,260	4,300	4,219	4,168	4,250
Large power and light	197	192	184	178	173	150	147	153
Other	102	107	106	115	122	125	121	117
People in homes served (1,000)	93,853	96,915	100,855	97,424	102,695	104,882	105,000	107,000
Per cent of total civil population	73.1	74.9	77.3	74.0	78.0	77.4	77.3	80.0
EMPLOYEES, total	279,000	270,000	269,000	265,000	270,000	.....	226,800	220,000

* Estimated, generally on ten months' operations. [1] Includes warrants and rights. [2] Revised figures beginning with 1937 conform to Uniform System of Accounts. [3] Includes other electric, in addition to light and power.

Slower Rates of Increase

HIGHLIGHTS

OUTPUT: 231 Billion Kw.-Hr.

Gain in 1944 over 1943 only 4.5 percent. Hydro power slightly under 1943 levels. Output from government plants rose to 19.2 percent of the total.

CAPACITY: 50.5 Million Kw.

Up 2.6 percent. Increase since war, 25 percent. Federally owned plants just under 10 percent. State projects, power districts, cooperatives contribute another 10.3 percent. Hydro reached new high with 29.1 percent of total.

NEW CAPACITY: 1.5 Million Kw.

Additions for 1945 are roundly 1.3 million kw., with steam three times as great as hydro. Two million kw. for 1946 and later show steam with a five-to-one ratio over hydro.

CUSTOMERS: 33 Million

Growth rate triples that of 1943. Half million residential customers added. Middle Atlantic region increase points to reversal of population shift. Drop in commercial and industrial customers in 1942 and 1943 changes to rise in 1944.

ENERGY SALES: 198 Billion Kw.-Hr.

Increase over 1943 only 6.2 percent. Residential sales larger by 8.1 percent. Small light and power gains over 1943 by 5.4 percent. Large light and power registered a one-third gain over 1943.

REVENUE: 3.3 Billion Dollars

Small gain made in 1944 over 1943. Residential revenue in 1944 largest industry has known. Average residential bill now 3.5 cents per kw.-hr. Rural customer averages $70.80 annually.

OPERATING EXPENSES: 1.2 Billion Dollars

Operating expenses increased less rapidly in 1944 than in 1943. Upward trend of operating ratios continues. Taxes take 23.9 cents of each dollar; salaries and wages, 12.9 cents; fuel, 2.9 cents per dollar more than the 10.8 cents in 1943.

BUDGET: 663 Million Dollars

Projected expenditures, largest since 1930, indicate industry is ready to go on expansion and rehabilitation of plant.

MANUFACTURING

Shipment index in September, 1944, hit a record, 610. Production index for year up to 553, 2 percent above 1943. Order index rose to 400. Inventories drop.

REA: 1.9 Billion Kw.-Hr. Sold

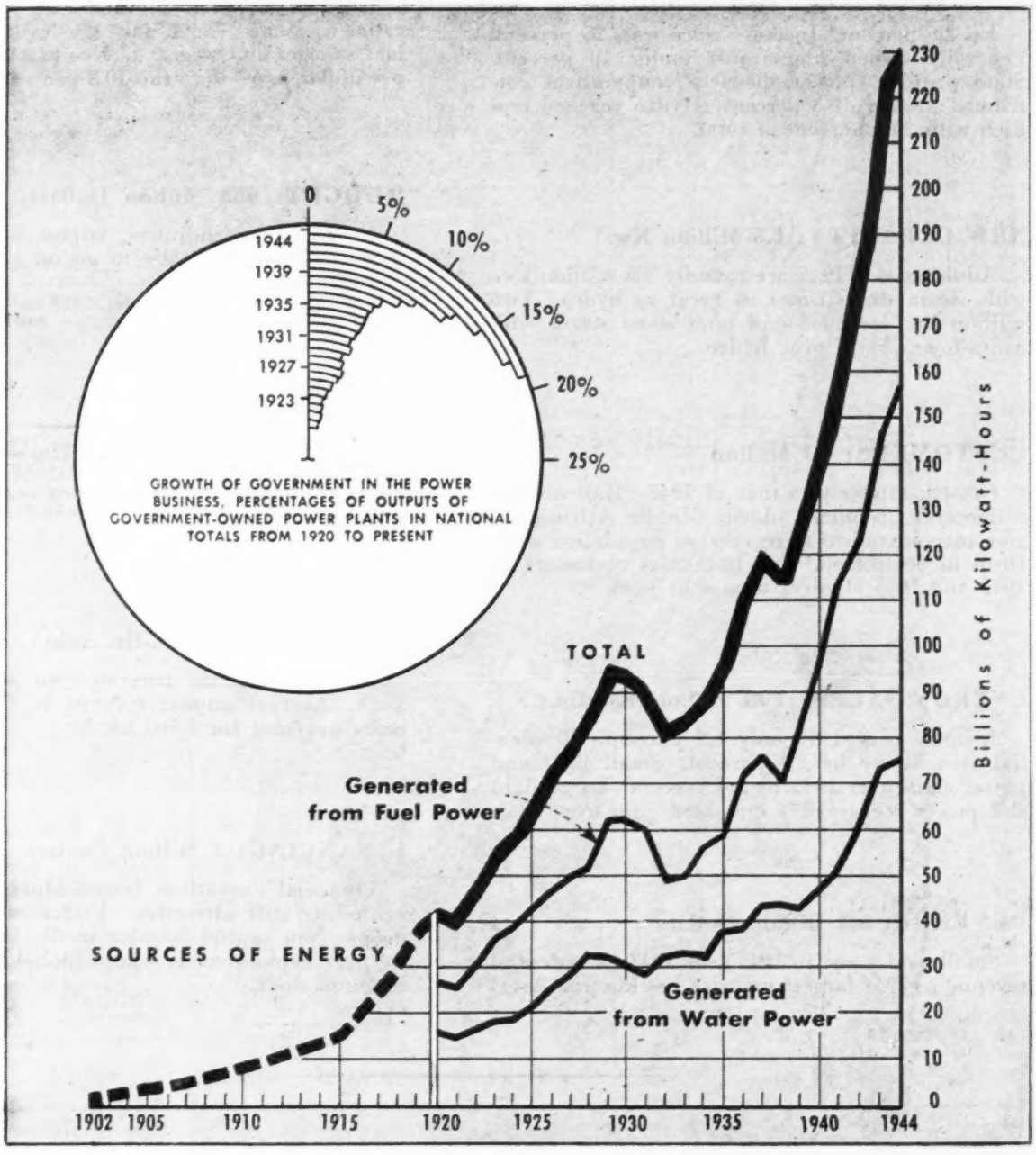
Sixty-five systems generate own power (73,000 kw.). Average annual revenue is $51.70 at 3.32 cents per unit for 1,560 kw.-hr.

FINANCING: 1 Billion Dollars

Financial operations largest since 1936. Bond refunding still attractive. Preferred stock yield drops. New capital remains small—internal funds support expansion. A one-million-dollar issue of common stock.

230,912,000,000 Kw.-Hr.

OUTPUT



Energy Production by Regions

(In Millions of Kw.-Hr.)

Region	1941			1942			1943			1944*		
	Fuel Power	Water Power	Total	Fuel Power	Water Power	Total	Fuel Power	Water Power	Total	Fuel Power	Water Power	Total
N.E.	7,882	2,549	10,431	7,975	3,188	11,163	8,369	3,818	12,187	9,359	3,076	12,435
M.A.	34,029	7,283	41,312	35,363	9,506	44,869	40,820	9,756	50,576	40,963	8,747	49,710
E.N.C.	36,296	3,089	39,385	39,819	3,516	43,335	46,815	3,569	50,384	50,573	3,142	53,715
W.N.C.	7,240	2,732	9,972	7,583	3,035	10,618	8,576	2,961	11,537	9,269	2,989	12,258
S.A.	16,172	4,808	20,980	16,697	7,147	23,844	19,174	2,852	27,026	20,752	7,553	28,305
E.S.C.	3,914	6,172	10,086	4,300	8,394	12,694	5,103	10,072	15,175	5,097	10,830	15,927
W.S.C.	8,061	779	8,840	9,209	927	10,136	12,021	900	12,921	13,202	1,078	14,280
Mountain	1,546	7,713	9,959	1,744	9,047	10,792	1,720	11,121	12,841	1,614	11,523	13,137
Pacific	1,768	16,137	17,905	2,311	19,419	21,729	4,429	23,894	28,323	5,556	25,589	31,145
U.S.	116,908	51,262	168,170	125,002	64,179	189,181	147,027	73,943	220,970	156,385	74,527	230,912

Source: Federal Power Commission. * Estimated.

Increase in kilowatt-hour output in 1944 over 1943 was 4.5 percent, a figure substantially less than the corresponding 1943 and 1942 increases. The fact is that war production, insofar as it is reflected in electrical energy consumption, has reached its peak. Study of the weekly outputs shows further that the peak was passed last winter, the spring and early summer outputs declining sharply. In late summer and fall the operations flattened out and since mid-October the weekly outputs have been consistently under the record making values of 1943.

Of the total generation 32.3 percent came from hydro plants in 1944 against the 33.4 percent in 1943 and 33.9 in 1942. Eastern farmers called it a dry year but the summer deficiency did not affect hydro output severely.

Privately owned enterprises produced 80.8 percent of the kilowatt-hours and governmentally owned projects 19.2 percent. Of this latter amount, the federal plants contributed practically two-thirds and the municipals and cooperatives one-third. However, the government group as a whole, due to generating additions, provided an increase in output which was almost equal to the added output of privately owned groups.

Production of Electric Energy by Ownership

(In Millions of Kw.-Hr.)

Year	Privately Owned				Government Owned		
	Electric Utilities	Mining and Mfg.	Railways	Sub-total	Local†	Federal	Sub-total
1930	86,108	790	2,750	89,648	4,538	465	5,003
1931	82,597	789	2,590	85,975	4,257	497	4,754
1932	74,488	596	2,388	77,472	4,460	445	4,905
1933	76,668	740	2,256	79,664	4,614	459	5,072
1934	82,079	1,193	2,355	85,627	4,822	357	5,179
1935	89,330	831	2,346	92,506	5,403	555	5,958
1936	102,293	667	2,198	105,159	5,950	1,072	7,023
1937	110,464	784	2,140	113,388	6,606	1,843	8,449
1938	104,090	857	2,012	106,959	6,693	3,029	9,722
1939	115,078	851	1,843	117,772	7,088	5,476	12,564
1940	125,411	908	1,323	127,642	8,758	8,584	17,342
1941	144,289	851	816	145,956	11,420	10,794	22,214
1942	158,052	621	876	159,549	12,739	16,893	29,633
1943	180,247	622	956	181,825	14,661	24,484	39,145
1944*	185,966	‡	1,030	186,996	15,170	28,746	43,916

Source: Federal Power Commission. * Estimated. † Includes cooperatives, power districts, state projects. ‡ Eliminated from series.

Source and Disposal of Energy

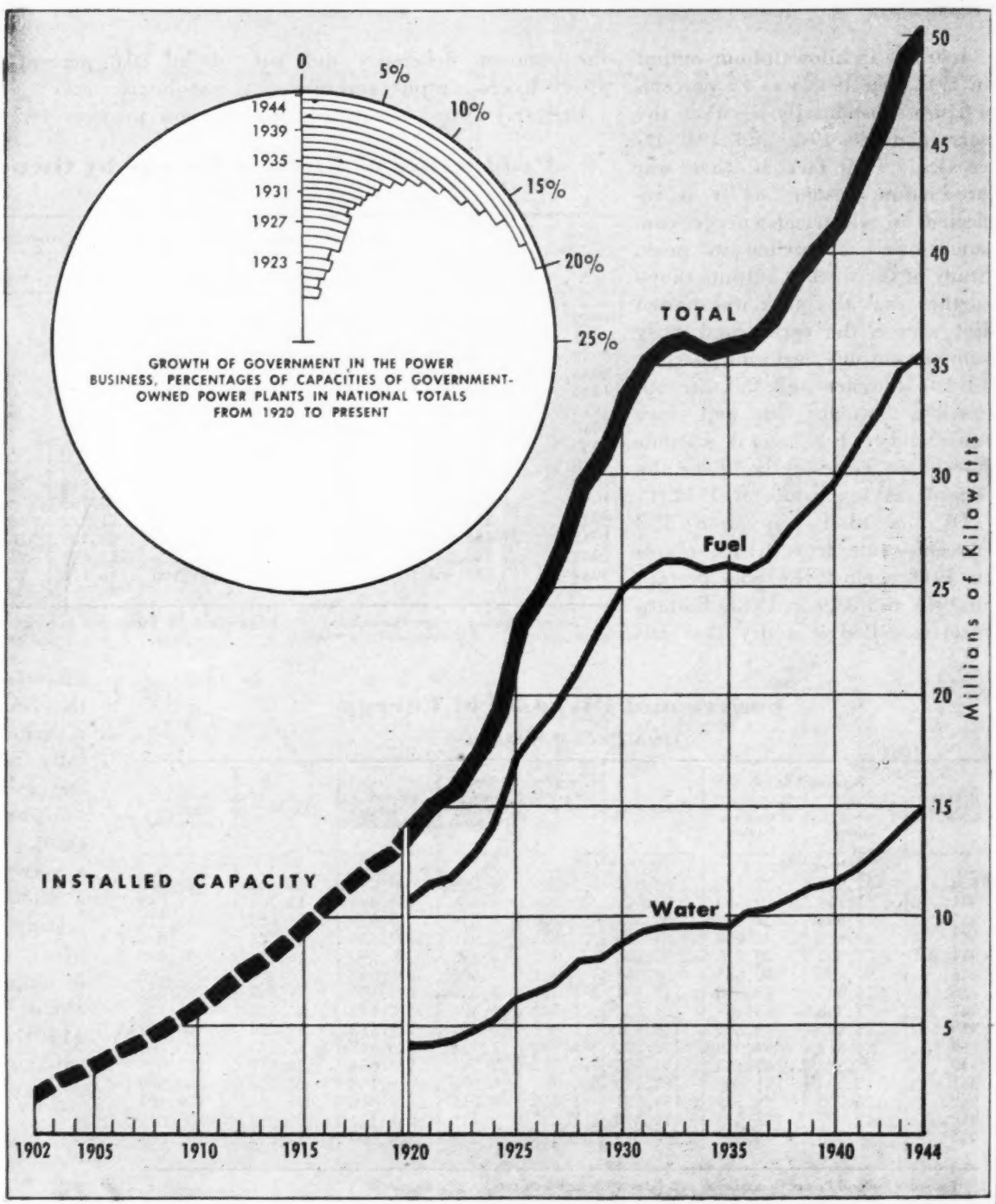
(In Millions of Kw.-Hr.)

Year	Generated from		Total Generation	Add Imports from Canada	Less Energy Used by Producer	Total for Distribution	Losses	Sales to Ultimate Consumers
	Fuel Power	Water Power						
1930	62,914	31,738	94,652	1,084	6,269	89,467	14,561	74,906
1931	61,149	29,580	90,729	794	5,459	86,064	14,162	71,902
1932	49,055	33,322	82,377	446	5,248	77,575	13,864	63,711
1933	50,678	34,058	84,736	613	4,910	80,439	14,523	65,916
1934	57,093	33,713	90,806	893	5,499	86,200	15,118	71,082
1935	59,430	39,034	98,464	901	5,669	93,696	16,100	77,596
1936	72,665	39,516	112,181	1,054	5,826	107,409	17,365	90,044
1937	77,348	44,489	121,837	1,733	6,428	117,142	17,783	99,359
1938	71,847	44,834	116,681	1,867	6,990	111,558	17,826	93,731
1939	86,314	44,022	130,336	1,900	7,734	124,502	18,735	105,768
1940	97,232	47,753	144,985	937	7,268	138,654	20,011	118,643
1941	116,908	51,262	168,170	927	6,335	162,762	22,702	140,060
1942	125,002	64,179	189,181	1,448	6,611	184,018	24,611	159,407
1943	147,027	73,943	220,970	1,537	9,729	211,124	25,235	185,889
1944*	156,385	74,527	230,912	1,625	5,225	224,800	27,200	197,600

Sources: Federal Power Commission and Edison Electric Institute. * Estimated.

50,524,000 Kw.

CAPACITY



Generating capacity total for the nation during 1944 grew to exceed 50 million kilowatts for the first time — actually 50,524,000. That represents an increase of 25 percent in the five years since the European war began, a doubling since 1927 and a more than six-fold increase since the previous World War started. Half of the five-year increase of 10,000,000 kilowatts had been placed in service before the United States had been in the war more than six months. The 1944 addition was only 1,200,000 kw. and 2.6 percent—the big year was 1943 when 2,900,000 kw. was the amount added in 6.2 percent increment.

Local and federal governmental bodies combined now own just a hair over 20 percent of the national generating capacity, having crept up from a 19.4 percent figure last year. The Federal government's plants, mostly hydro, represent 9.8 percent of the total. Power districts, state projects and cooperatives provide the other 10.3 percent.

Water power inched upward to 29.1, a new high percentage of the total capacity. Over the last eight years this proportion had hovered between 27.8 and 28.6 but the large added units in the Western and TVA developments during 1944 caused a fairly significant spurt.

For the third consecutive year the major part of the national additions were made in the Pacific and Southern belts where the industrial expansion has been most striking. First place in percentage growth was taken (at 7.0) by the Pacific states; E.S.C. took second place with 5; others in order were W.S.C. with 3.2, S.A. with 3.0, Mountain with 2.4, E.N.C. with 1.9, W.N.C. with 1.0, M.A. with 0.8; New England shows at 0.3 percent decrease due to adjustments in the hydro category. Decreases in total rating of fuel power stations in E.S.C., Mountain and Pacific along with decreases in hydro figures in E.N.C., W.N.C. and S.A. are to be credited to one or more of the following causes; omission of certain manufacturing and mining operations in the 1944 figures, retirement of worn out equipment, or derating for sustained loading.

Generating Capacity by Ownership

(In Thousands of Kw.)

Year	Privately Owned				Government-Owned		
	Electric Utilities	Mining and Mfg.	Railways	Sub-total	Local†	Federal	Sub-total
1930	30,285	438	1,232	31,956	1,873	226	2,099
1931	31,498	431	1,240	33,170	1,969	230	2,200
1932	32,033	388	1,216	33,638	2,122	232	2,354
1933	32,163	458	1,198	33,819	2,191	232	2,423
1934	31,547	449	1,223	33,220	2,283	288	2,571
1935	31,820	449	1,190	33,459	2,316	300	2,615
1936	31,787	447	1,036	33,270	2,492	803	3,295
1937	31,958	494	1,021	33,472	2,829	832	3,662
1938	33,246	559	991	34,796	3,090	1,156	4,246
1939	33,908	559	896	35,363	3,304	1,650	4,955
1940	34,399	603	499	35,501	4,195	1,944	6,138
1941	36,041	601	476	37,118	4,603	2,371	6,974
1942	37,442	267‡	476	38,186	5,005	3,216	8,221
1943	39,128	267	476	39,871	5,112	4,322	9,434
1944*	39,904	§	476	40,380	5,205	4,939	10,144

Source: Federal Power Commission. * Estimated. † Includes cooperatives, power districts and state projects. ‡ Adjustment. § Eliminated from series.

Installed Capacity

(In Thousands of Kw.)

Year	Type of Prime Mover		
	Fuel	Water	Total
1930	25,114	8,941	34,055
1931	25,925	9,445	35,370
1932	26,408	9,583	35,991
1933	26,507	9,736	36,243
1934	26,049	9,742	35,791
1935	26,279	9,795	36,074
1936	26,128	10,436	36,564
1937	26,558	10,577	37,135
1938	27,976	11,066	39,042
1939	28,903	11,415	40,318
1940	29,964	11,675	41,639
1941	31,828	12,264	44,092
1942	33,381	13,025	46,407
1943	35,238	14,067	49,305
1944*	35,805	14,719	50,524

Source: Federal Power Commission. *Estimated.

Generating Capacity by Regions

(In Thousands of Kw.)

Region	1941			1942			1943			1944*		
	Fuel	Water	Total	Fuel	Water	Total	Fuel	Water	Total	Fuel	Water	Total
N.E.	2,295	873	3,168	2,467	904	3,371	2,542	906	3,448	2,540	896	3,436
M.A.	8,841	1,599	10,440	9,167	1,603	10,770	9,385	1,594	10,979	9,466	1,594	11,060
E.N.C.	9,383	716	10,099	9,808	729	10,537	10,384	750	11,134	10,603	746	11,349
W.N.C.	2,806	600	3,406	2,902	599	3,501	2,934	598	3,542	2,988	579	3,567
S.A.	3,392	2,164	5,556	3,680	2,210	5,889	4,017	2,211	6,228	4,268	2,153	6,421
E.S.C.	846	1,432	2,278	1,012	1,637	2,649	1,198	1,852	3,050	1,181	2,022	3,203
W.S.C.	1,970	279	2,249	2,070	301	2,371	2,286	301	2,587	2,301	371	2,672
Mountain	669	1,692	2,361	653	1,784	2,437	666	1,924	2,590	652	2,004	2,656
Pacific	1,626	2,909	4,535	1,623	3,258	4,881	1,825	3,931	5,756	1,806	4,354	6,160
U.S.	31,828	12,264	44,092	33,382	13,025	46,407	35,237	14,067	49,304	35,805	14,719	50,524

Source: Federal Power Commission. * Estimated.

Generator Rating—Central Stations, Municipal, Railway and Other Utility Power Plants

Preliminary as of November 1, 1944

Division and State	Number of Companies	Number of Plants	Total Capacity Kilowatts	Generator Capacity in Kilowatts of Plants Operated by [a]					
				Water Power		Steam Power		Internal Combustion Engines	
				Number	Capacity	Number	Capacity	Number	Capacity
United States	[b] 1,705	3,965	50,244,703	1,515	14,579,970	1,107	34,602,088	1,343	1,062,645
New England	118	329	3,435,961	227	896,371	78	2,514,685	24	24,905
Maine	23	85	338,904	66	248,397	8	87,240	11	3,267
New Hampshire	13	56	315,225	47	233,215	6	80,430	3	1,580
Vermont	21	74	176,369	65	[c] 161,927	7	13,750	2	692
Massachusetts	41	73	1,493,582	30	162,862	38	1,319,475	5	11,245
Rhode Island	6	11	284,721	4	3,250	5	278,450	2	3,021
Connecticut	14	30	827,160	15	86,720	14	735,340	1	5,100
Middle Atlantic	121	381	11,060,325	206	1,593,645	141	9,426,392	34	40,288
New York	62	231	5,986,469	166	1,161,740	49	4,798,475	16	26,254
New Jersey	13	24	1,572,157	3	7,270	16	1,560,950	5	3,937
Pennsylvania	46	126	3,501,699	37	424,635	76	3,066,967	13	10,097
East North Central	316	675	11,298,844	296	746,184	248	10,427,533	131	125,127
Ohio	69	106	3,127,112	7	12,125	78	3,098,189	21	16,798
Indiana	54	81	1,540,792	19	35,194	47	1,489,935	15	15,663
Illinois	62	97	3,044,837	13	52,166	60	2,969,314	24	23,357
Michigan	63	195	2,386,800	129	369,205	30	1,970,875	36	46,720
Wisconsin	68	196	1,199,303	128	277,494	33	899,220	35	22,589
West North Central	488	888	3,566,490	139	578,519	225	2,616,168	524	371,803
Minnesota	80	158	834,459	47	142,254	49	642,814	62	49,391
Iowa	97	180	757,332	32	132,823	49	530,415	99	94,094
Missouri	74	114	844,991	7	151,050	32	637,243	75	56,698
North Dakota	18	43	100,365	.....	.....	17	89,338	26	11,027
South Dakota	46	76	93,031	5	3,270	11	55,112	60	34,649
Nebraska	85	180	416,927	41	142,385	34	220,266	105	54,276
Kansas	88	137	519,385	7	6,737	33	440,980	97	71,668
South Atlantic	151	402	6,306,132	158	2,086,052	131	4,128,425	113	91,655
Delaware	6	8	38,912	.....	.....	4	33,200	4	5,712
Maryland	12	28	852,899	3	271,325	12	572,525	13	9,049
District of Columbia	2	3	408,000	1	3,000	2	405,000	.....	.....
Virginia	27	71	841,766	36	182,099	18	645,490	17	14,177
West Virginia	13	37	997,205	11	100,940	16	891,510	10	4,755
North Carolina	30	80	1,214,668	48	522,460	20	679,221	12	12,987
South Carolina	16	44	792,468	28	650,643	10	137,330	6	4,495
Georgia	16	57	666,601	27	342,892	23	321,375	7	2,334
Florida	29	74	493,613	4	12,693	26	442,774	44	38,146
East South Central	65	162	3,148,725	38	1,990,160	71	1,134,427	53	24,138
Kentucky	17	37	491,717	4	142,860	25	345,790	8	3,067
Tennessee	18	41	1,271,463	22	901,517	13	368,020	6	1,926
Alabama	6	35	1,323,382	12	945,783	14	372,990	9	4,609
Mississippi	24	49	62,163	.....	.....	19	47,627	30	14,536
West South Central	179	409	2,652,122	36	370,847	97	2,060,348	276	220,927
Arkansas	26	44	222,309	6	102,008	14	102,950	24	17,351
Louisiana	36	63	544,321	.....	.....	9	496,320	54	48,001
Oklahoma	54	106	464,615	4	59,224	23	351,118	79	54,273
Texas	63	196	1,420,877	26	209,615	51	1,109,960	119	101,302
Mountain	188	426	2,656,078	201	2,004,030	68	544,140	157	107,908
Montana	22	41	373,384	22	358,273	4	11,968	15	3,143
Idaho	17	60	268,058	46	264,065	1	400	13	3,593
Wyoming	31	50	82,616	14	49,440	11	27,537	25	5,639
Colorado	40	86	352,458	30	87,985	26	247,719	30	16,754
New Mexico	22	45	149,364	5	25,157	13	103,091	27	21,116
Arizona	20	52	671,524	15	540,790	10	87,175	27	43,559
Utah	28	77	168,897	59	92,185	3	66,250	15	10,462
Nevada	8	15	589,777	10	586,135	.....	.....	5	3,642
Pacific	79	293	6,120,026	214	4,314,062	48	1,749,970	31	55,894
Washington	24	62	1,823,725	45	1,619,380	10	202,320	7	2,025
Oregon	24	71	901,779	50	712,267	12	184,550	9	4,962
California	31	160	3,394,522	119	1,982,515	26	1,363,100	15	48,907

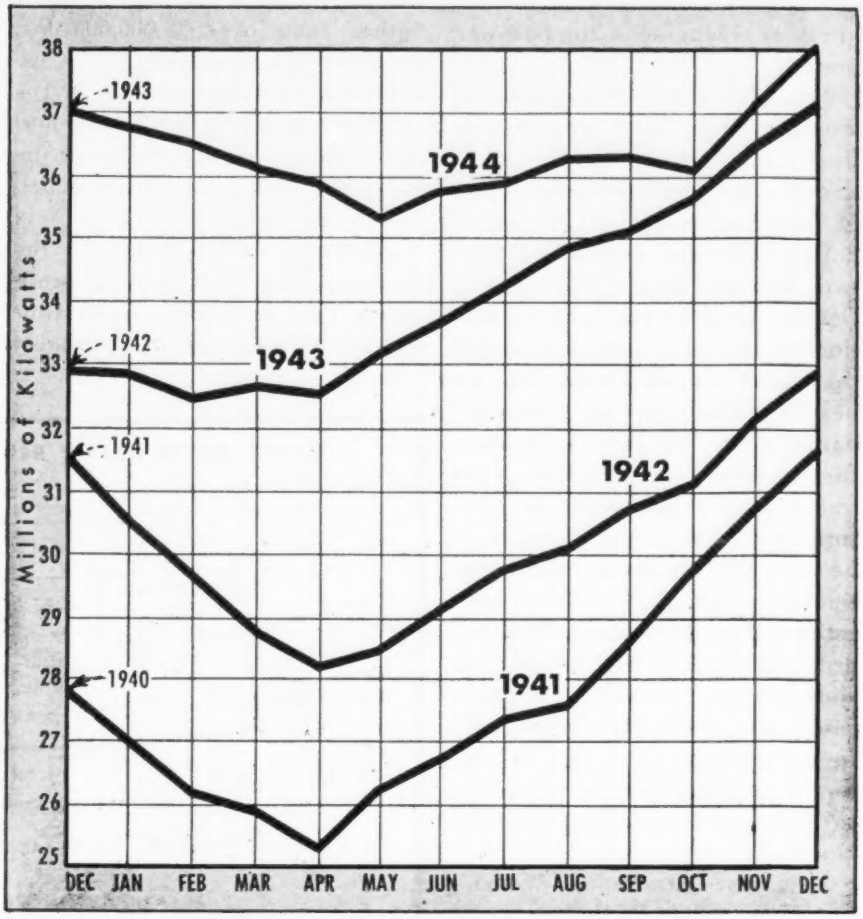
Notes: [a] For the approximately 184 combination plants each type of prime mover is counted as a separate plant.
[b] Total includes 88 duplications because of utilities having generating plants in more than one state.
[c] Includes 1,000 kilowatts wind power.

PEAKS AND CAPACITIES

Implicit in the discussion in this space last year of electric utility peak loads and of generating capacity to carry them was the confident expectation that the war in Europe would end in 1944. That expectation has been sorely disappointed. But the confidence then expressed in the ability of the utilities to carry the war load has been mostly satisfyingly vindicated. And all the evidence presently at hand justifies the same confidence for the year ahead. Probably even greater confidence can be felt, considering that the industry now has three years of proven competence in its wartime job as solid ground to stand on.

These three years have seen an unprecedented increase in demand for electric power; in round numbers from less than 32,000,000 kw. of aggregate peak in 1941 to over 38,000,000 kw. estimated for 1944, an increase of more than 20 percent of which nearly all occurred in one year. During the three-year period, established ideas and practices in regard to generating capacity requirements were forced by wartime scarcities of labor and materials to undergo drastic modifications. Capacity could not keep pace with load in the accustomed way.

At the end of 1941, generating capacity (nameplate rating*) totalled 44,092,000 kw. and at the end of 1944, 50,524,000, an increase of less than 15 percent with which the over 20 percent increase in load was met. Not only was it necessary to load capacity more heavily. That stunted-growth capacity had to work longer hours to turn out the energy used in war production, 18 percent longer in 1944 than in 1941. Thus it has been that in the three years of war so far, electricity production equipment has carried heavier loads for longer hours than had been the practice in pre-war days.



Behavior of monthly peak loads

The slowing down of growth in peak loads and in outputs of electric utilities in 1944 resulted only partially from mistaken confidence that the European war would end in that year. More determining in the decrease of growth rate was the fact that the job of building the war production plant approached completion. The amount of new load added to utility systems was a decreasing quantity during 1943 and 1944. Cutbacks in war production did have their effect, of course, but not nearly so much effect as did the fact that fewer new plants were built for war production during the year.

Thus the utilities are not now faced with the problems of taking on new load, as they were in 1942 and 1943, on production equipments and other system facilities that could not be increased as fast as previously established ideas of good operation had indicated as necessary. They are, however, confronted with another problem just as vexing. This is the job of keeping heavily loaded facilities producing and handling increas-

* The difference between these figures and those of "Dependable Capacities" in the table results from the Federal Power Commission's definition of the term. It excludes much capacity that is capable of carrying load except under extreme conditions of water scarcity or other limitation.

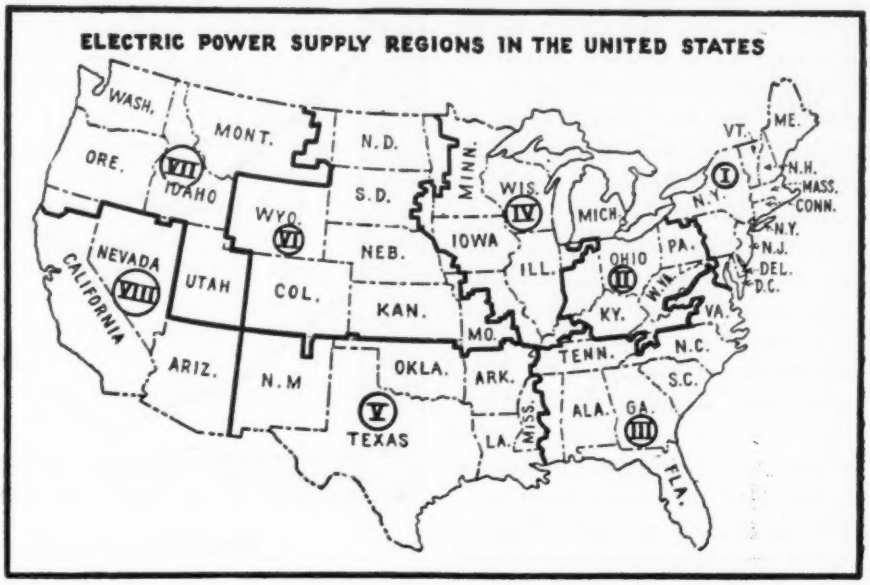
ing quantities of kilowatt-hours. In time, but hardly in the foreseeable duration of the war in Europe, these facilities will wear out and will have to be replaced. But this is a situation that can be envisioned comfortably and definitely as belonging in the post-war period.

The 1944 curve of behavior of monthly peak loads appears on the accompanying graph in a shape quite different from those of previous years. It is much flatter than the others and has two distinct dips. The dip in October must be taken as a reflection of the then prevalent belief that the Germans would soon be beaten. The rise in November parallels the growing realization that to breach the Siegfried Line was a harder job than had been supposed. Also it may very well be that the November and December points on the curve—both estimated by ELECTRICAL WORLD—are higher than the record will show them. Estimates in both cases were intended deliberately to be generous so as not to present a brighter picture of ability to carry load than might be disclosed by events.

Last year ELECTRICAL WORLD'S estimate of the December, 1943, aggregate peak load was 37,130,000 kw. The actual peak was 37,060,000 kw., 0.19 percent less than the estimate. The estimate of 38,081,000 kw. now made for December, 1944, probably will not be as close. After the estimate was made opinions were received indicating that the peak is more likely to be under rather than over 38,000,000 kw. However the possibility of an extraordinarily dark day late in December was felt to justify a generous estimate; also, as stated in the preceding paragraph, it seems better to err towards safety.

Although developments on the western front last month prove again that prophecy in wartime can only be guessing, it is probably a safe prediction that loads on utility systems will not add up to a much higher aggregate peak in December, 1945, than the record will show for that month in 1944. Pressed for a definite figure, one could guess at 38,500,000 kw. and feel quite sure that it would not be exceeded.

Margins between aggregate peaks and dependable capacities in 1944 were changed from 1943, but not in any region so narrowed as to be cause for apprehension. In general, the regional picture is improved, and it adds up to a rise from 14.4 to 15.6 percent in national terms.



Margins of Dependable Capacities above Peaks

(In Thousands of Kw.-Hr.)

Regions	December, 1941			December, 1942			December, 1943			December, 1944		
	Peaks	Depend. Cap.*	Percent Margins	Peaks	Depend. Cap.*	Percent Margins	Peaks	Depend. Cap.*	Percent Margins	Peaks	Depend. Cap.*	Percent Margins
I	9,789	11,614	18.6	9,613	11,952	24.2	10,557	12,254	16.0	10,641	12,261	15.0
II	6,514	7,715	18.4	6,848	8,093	18.3	7,608	8,561	11.2	7,646	9,001	17.7
III	3,837	4,036	5.2	4,364	4,877	11.7	4,767	5,172	8.5	5,267	5,675	7.8
IV	4,325	5,103	18.0	4,345	5,285	21.7	4,642	5,717	23.2	4,828	5,762	19.3
V	1,547	2,018	30.5	1,781	2,112	18.8	2,103	2,383	13.3	2,324	2,528	8.6
VI	785	1,170	49.0	849	1,215	43.3	926	1,250	35.0	1,005	1,255	25.0
VII	1,998	2,159	8.0	2,309	2,463	6.7	2,917	3,073	5.4	2,756	3,259	18.3
VIII	2,774	3,543	27.8	2,833	2,678	29.2	3,540	4,007	13.1	3,614	4,350	20.4
Total	31,569	37,358	18.3	32,942	39,665	20.4	37,060	42,417	14.4	38,081	44,091	15.6

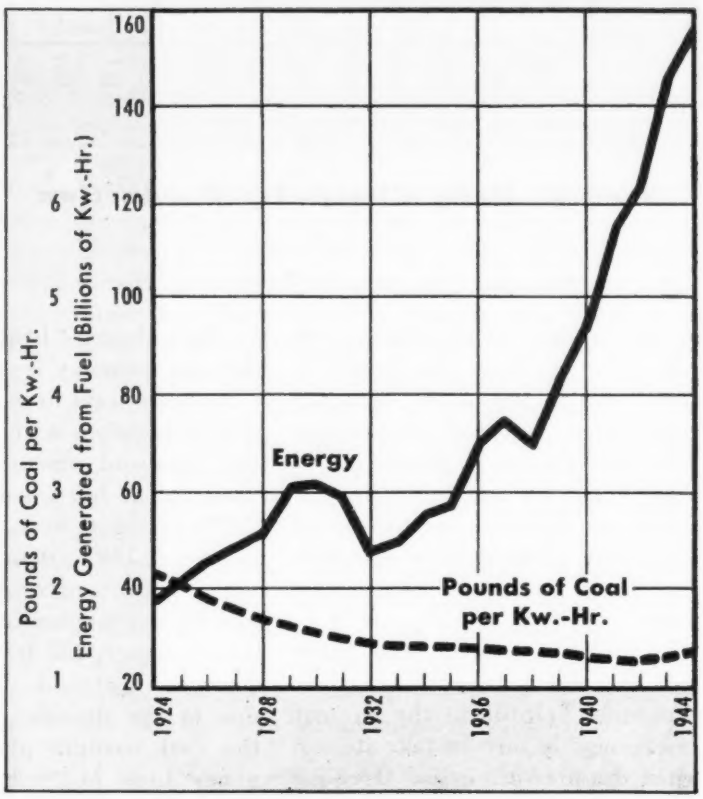
* Includes reserves and net firm purchases. † Estimated by ELECTRICAL WORLD on ten-month record in 1943. Source — Federal Power Commission.

4,626 Kw.-Hr. per Kw. of Capacity

STATION ECONOMICS

Sustained production of electrical energy for implementing our armed forces quite naturally had the result of calling for more output from more generating capacity than was the case in even the previous banner year of 1943. Not only were both output and capacity greater but the output per unit of capacity was slightly greater than ever before, indicating that every bit of generating capacity is being counted on to do its stint for the war effort.

Obsolescent equipment that in normal times would be withdrawn is backing up the comparatively limited amount of freshly added capacity to a notable degree. In 1943 the added capacity would have had to be worked 1,844 more hours than there are in a year to turn out the increased output demanded. In 1944 the capacity added during the year, if applied to produce all the added output would have had to work only 8,140 hours (500 of potential idleness for overhaul). That more of the load was shared by the existing units, including the over-age ones, than even in 1943 is the conclusion that can be drawn.



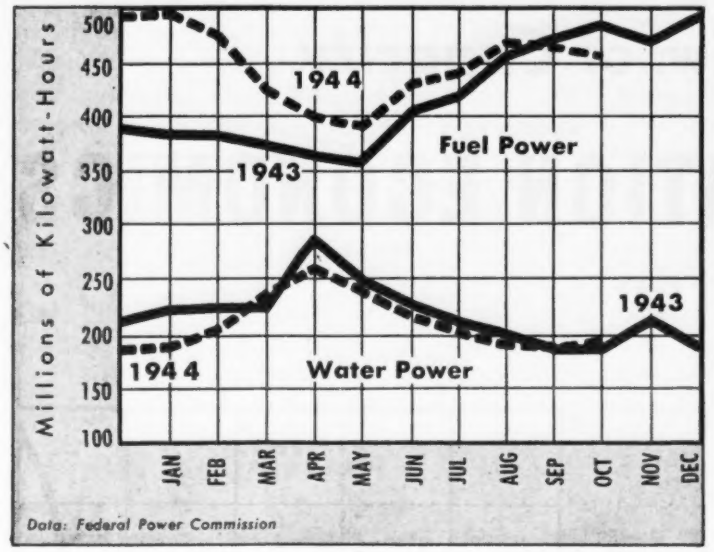
Output from Fuel and Fuel Used

Taking the overall capacity and overall generation it is notable that the wartime demands for electrical energy in 1944 were such as to necessitate more hours (4,626) of equivalent full-tilt loading than at any previous time in the history of the industry, not excepting 1943. It all serves as a testimonial to the competency and reliability of the plant equipment and of the operators because back

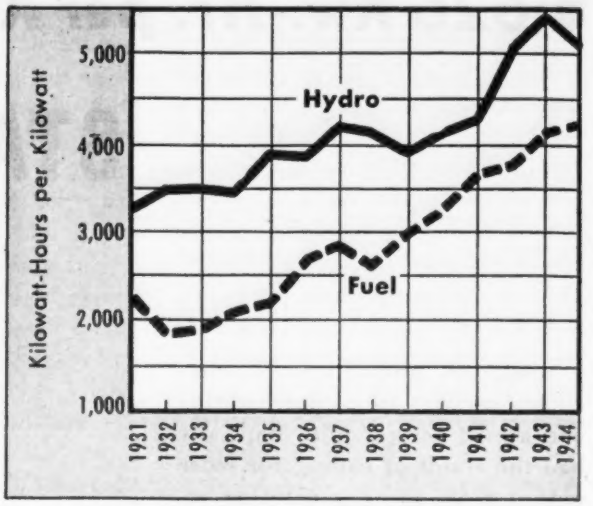
Output, Capacity, Average Use

Year	Energy Generated (Millions of Kw.-Hr.)			Generated Capacity at end of year (Thousands of Kw.)			Output per Kw. of Ave. Cap. (Kw.-Hr.)		
	Fuel	Water	Total	Fuel	Water	Total	Fuel	Water	Total
1931	61,149	29,580	90,729	25,925	9,445	35,370	2,396	3,218	2,614
1932	49,055	33,322	82,377	26,408	9,583	35,991	1,875	3,502	2,309
1933	50,678	34,058	84,736	26,507	9,736	36,243	1,915	3,526	2,346
1934	57,093	33,713	90,806	26,049	9,742	35,791	2,173	3,462	2,521
1935	59,430	39,034	98,464	26,279	9,795	36,074	2,271	3,996	2,740
1936	72,665	39,516	112,181	26,128	10,436	36,564	2,773	3,906	3,089
1937	77,348	44,489	121,837	26,558	10,577	37,135	2,936	4,234	3,306
1938	71,847	44,834	116,681	27,976	11,066	39,042	2,635	4,143	3,063
1939	86,314	44,022	130,336	28,903	11,415	40,318	3,035	3,916	3,285
1940	97,232	47,753	144,985	29,964	11,675	41,639	3,303	4,137	3,538
1941	116,908	51,262	168,170	31,828	12,264	44,092	3,784	4,283	3,923
1942	125,002	64,179	189,181	33,381	13,025	46,407	3,834	5,076	4,181
1943	147,027	73,943	220,970	35,237	14,068	49,305	4,285	5,458	4,617
1944*	156,385	74,527	230,912	35,805	14,719	50,524	4,396	5,178	4,626

Source: Federal Power Commission. * Estimated.



Average Daily Electricity Production



Average Use of Capacity

in the twenties it used to be felt necessary to limit the hours of active use to less than 3,000 per year. That required proportionately many more kilowatts of reserve than are now provided or available. The gain in investment is just one of the numerous factors that have encouraged rate reductions.

It can, however, be said again that this intensive working, while extremely helpful in the present emergency, is sure to take its toll when the pressure eases. Over-age and inefficient equipment will be slated quickly for discard as soon as the load relaxes to the point where newer units of better economy can carry the output. Logical additions to increase the present scant reserves will also encourage discard of old and relatively inefficient equipment. Maintenance costs will simultaneously drop to lower levels.

Despite the intensified loading and continued resort to obsolescent generating units the pounds of coal used per kilowatt-hour rose only two points, from 1.31 to 1.33. Figures reported a year ago showed 1.34 but revised data for 1943 indicates that 1943 was as good in this respect (1.31) as was 1942 which had been the best year in the industry's history as far as thermal economy is concerned.

As has always been the case and should be when water is ample in the lakes and streams so that fuel need not be burned unnecessarily, the hydro units were worked more hours (5,178) than the steam units (4,396). Average hours of full-capacity operation of hydro was, however, 280 less in the year than in 1943 and the drop was due to the drought. As a result the fuel burning plants attained a new high (4,396 hours) of operation or what is the same thing —kw.-hr. output per kw. of average capacity.

Natural gas consumption jumped nearly 20 percent and is now more than twice what it was before the war. Oil and natural gas together constitute a fuel contribution to power generation such that coal provides 79 percent of the heat units applied. In making these calculations 23,200 cubic feet of natural gas and 3.42 barrels of oil are taken equivalent to a ton of coal at 11,600 B.t.u. per pound.

Output from Fuel and Fuel Used

Year	Energy Generated from Fuel† (Millions of Kw.-Hr.)	Fuel Consumed				
		Coal (Millions of Tons)	Oil (Millions of Bbl.)	Gas (Billions of Cu. Ft.)	†† Coal Equiv. (Millions of Tons)	Pounds of Coal per Kw.-Hr.†
1929	62,295	44.93	10.19	112.62	52.64	1.69
1932	48,931	30.30	7.97	107.84	36.70	1.50
1933	50,546	30.58	9.95	102.73	37.15	1.47
1935	59,176	34.16	11.38	125.24	43.20	1.46
1936	72,188	42.03	14.12	156.08	51.99	1.44
1937	76,883	44.77	14.14	171.27	55.14	1.43
1938	71,525	40.21	13.08	170.69	50.56	1.41
1939	85,800	46.22	17.42	191.13	59.51	1.39
1940	96,609	53.40	16.77	183.16	65.14	1.35
1941	116,167	64.76	20.25	205.16	77.99	1.34
1942	124,401	68.42	15.28	238.74	81.44	1.31
1943	146,200	79.67	18.09	301.09	95.70	1.31
1944*	157,337	82.76	22.19	360.77	104.80	1.33

Source: Federal Power Commission.
† Output by use of wood not included.
* Twelve months ended October 31
†† Coal plus oil plus gas

Growth Picks Up Speed

CUSTOMERS

Growth in number of electric utility customers was more than three times as fast in 1944 as in 1943. The growth occurred in greater part in the residential customer class although it was considerably helped by a reversal in the commercial and industrial group which turned from decline in 1943 and 1942 to rise in 1944.

This reversal in the record of commercial and industrial customers may be taken as an indication that the business community of the nation has adjusted itself to the conditions of a war economy and is finding ways to live and grow under them. However, the ground lost in the declines in number of customers in 1942 and 1943 was only partially recovered in the rise in 1944, at the end of which year commercial and industrial customers totaled some 70,000 less than at the end of 1941. It is to be noted that customers of this class increased in number fairly evenly over the country, testifying to a general, rather than a sporadic adjustment to wartime conditions.

Nearly half a million residential customers were added to the lines in 1944. This is nearly 2 times the number added in 1943, but it does not come up to the increases of about 600,000 in 1942 and over a million in 1941. A point of interest is that the largest increase in 1944 occurred in the Middle Atlantic region (132,010) where in 1943 there was a decrease of 42,220. This looks as though the population shift, indicated by the decrease in 1943 had definitely changed direction insofar as this particular region is concerned. The figures for 1943 and 1944 apparently show continuation of movement of people into the South Atlantic, West South Central and Pacific regions.

The record of numbers of rural customers continues to defy analysis. As has been pointed out in discussions of this customer group in previous statistical numbers of this magazine, rural customers are reported as those served on distinct rural rate schedules. Some companies with large numbers of rural customers have no such rate schedules, but serve their rural areas on regular urban rates. In some cases rate changes may result in shifts of customers between rural and urban rate classes. And in any event the numbers of rural customers shown in the table do not represent farm customers because a great number of those in the rural rate class are not farmers but dwellers in suburban areas and small towns.

Thus there are some farm customers included in the classification of residential and some residential customers in the rural. Since farms have residences on them, the proper statement of number of residential customers should probably be taken as the sum of the two classifications.

Central Station Customers at End of Year*

	United States	New England	Middle Atlantic	East No. Central	West No. Central	South Atlantic	East So. Central	West So. Central	Mountain	Pacific
Total Customers										
1944	33,030,000	2,591,180	8,117,450	7,656,300	3,102,000	3,311,220	1,495,450	2,220,900	987,675	3,547,825
1943	32,396,300	2,554,968	7,985,301	7,544,097	3,061,067	3,231,127	1,447,934	2,129,965	968,178	3,473,663
Change	633,700	36,212	132,149	112,203	40,933	80,093	47,516	90,935	19,497	74,162
Rural Customers†										
1944	1,150,000	8,000	59,000	327,000	122,000	90,000	75,000	106,000	30,000	333,000
1943	1,088,698	8,872	68,997	303,925	115,611	88,680	68,990	95,932	19,781	317,910
Change	61,302	−872	−9,997	23,075	6,389	1,320	6,010	10,068	10,219	15,090
Residential Customers										
1944	27,360,000	2,245,000	6,923,000	6,430,000	2,493,000	2,754,000	1,227,000	1,777,000	803,000	2,708,000
1943	26,872,639	2,211,630	6,790,990	6,353,252	2,465,732	2,685,704	1,190,238	1,709,402	799,077	2,666,614
Change	487,361	33,370	132,010	76,748	27,268	68,296	36,762	67,598	3,923	41,386
Commercial & Industrial										
1944	4,403,000	331,000	1,113,000	875,000	475,000	457,000	184,000	326,000	152,000	490,000
1943	4,314,838	327,128	1,100,419	862,904	467,899	445,933	179,098	312,775	146,711	471,971
Change	88,162	3,872	12,581	12,096	7,101	11,067	4,902	13,225	5,289	18,029
Municipal, Rail & Misc:										
1944	117,000	7,180	22,450	24,300	12,000	10,220	9,450	11,900	2,675	16,825
1943	120,125	7,338	24,895	24,016	11,825	10,810	9,608	11,856	2,609	17,168
Change	−3,125	−158	−2,445	284	175	−590	−158	44	66	−343

*1943 Estimated. †Customers served on specific rural rates. Rural customers served on urban rates not included.

197,600,000,000 Kw.-Hr.

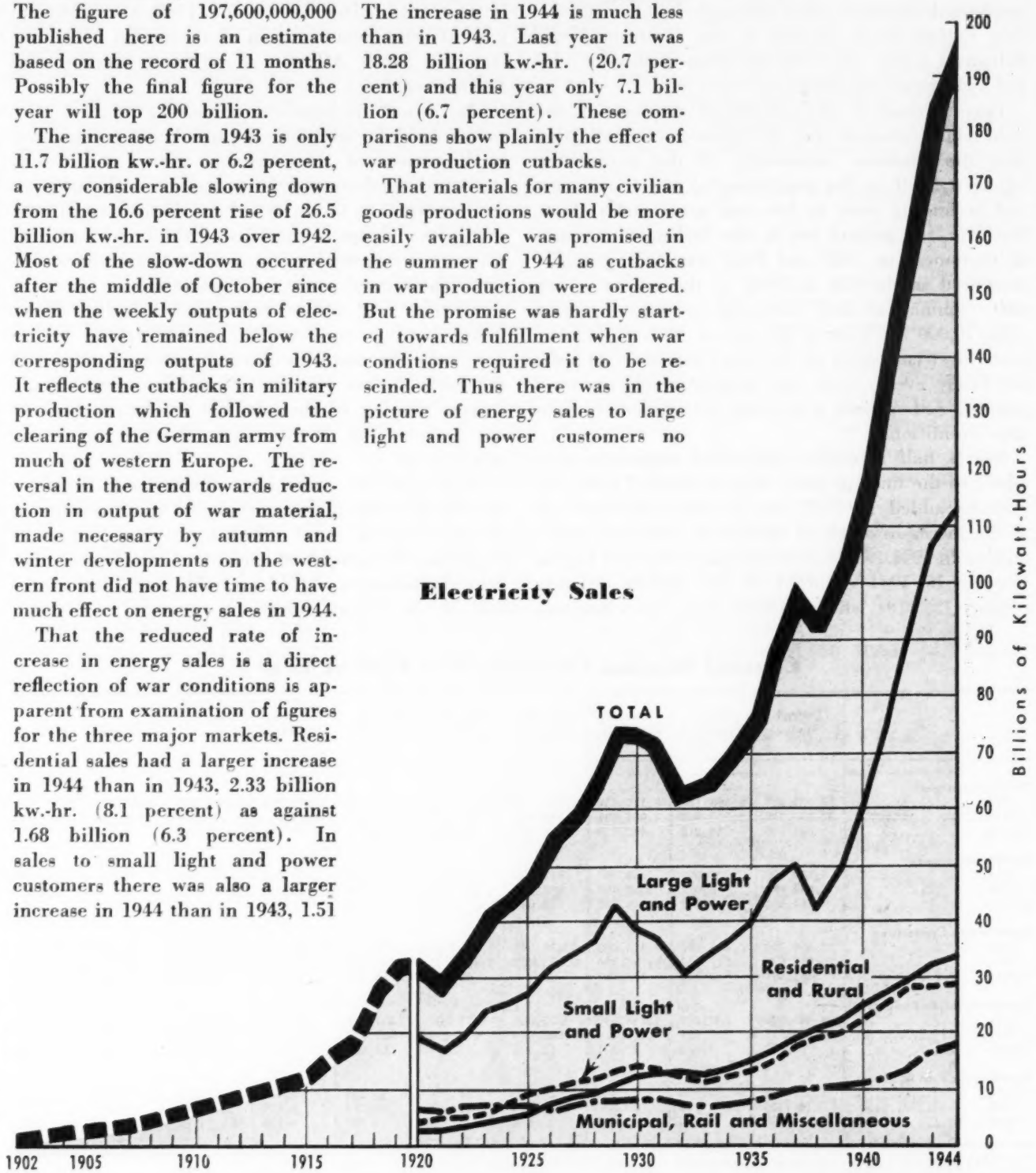
ENERGY SALES

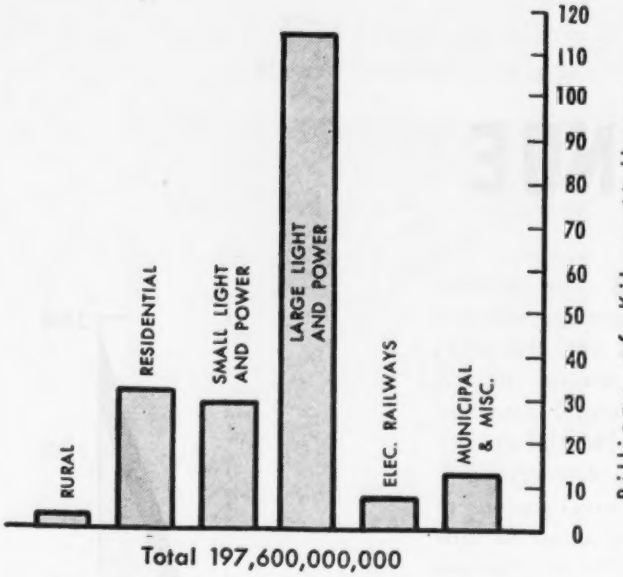
Within nearly one percent. That's how close to the 200 billion mark comes the number of kw.-hr. of energy sales in 1944. The figure of 197,600,000,000 published here is an estimate based on the record of 11 months. Possibly the final figure for the year will top 200 billion.

The increase from 1943 is only 11.7 billion kw.-hr. or 6.2 percent, a very considerable slowing down from the 16.6 percent rise of 26.5 billion kw.-hr. in 1943 over 1942. Most of the slow-down occurred after the middle of October since when the weekly outputs of electricity have remained below the corresponding outputs of 1943. It reflects the cutbacks in military production which followed the clearing of the German army from much of western Europe. The reversal in the trend towards reduction in output of war material, made necessary by autumn and winter developments on the western front did not have time to have much effect on energy sales in 1944.

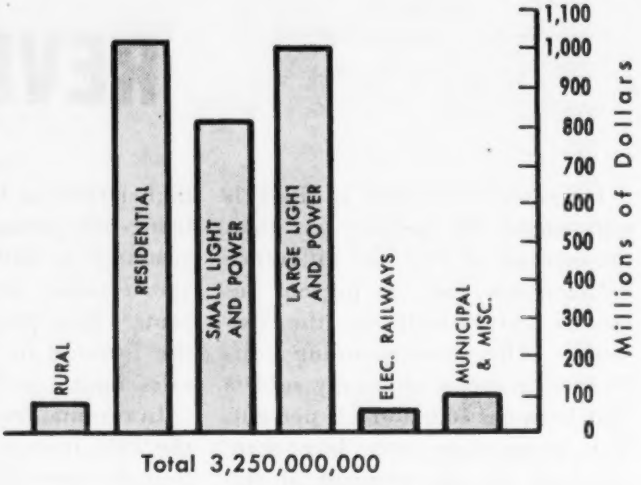
That the reduced rate of increase in energy sales is a direct reflection of war conditions is apparent from examination of figures for the three major markets. Residential sales had a larger increase in 1944 than in 1943, 2.33 billion kw.-hr. (8.1 percent) as against 1.68 billion (6.3 percent). In sales to small light and power customers there was also a larger increase in 1944 than in 1943, 1.51 billion kw.-hr., (5.4 percent) vs. 0.86 billion (3.2 percent). But in sales to large light and power customers the condition is opposite. The increase in 1944 is much less than in 1943. Last year it was 18.28 billion kw.-hr. (20.7 percent) and this year only 7.1 billion (6.7 percent). These comparisons show plainly the effect of war production cutbacks.

That materials for many civilian goods productions would be more easily available was promised in the summer of 1944 as cutbacks in war production were ordered. But the promise was hardly started towards fulfillment when war conditions required it to be rescinded. Thus there was in the picture of energy sales to large light and power customers no significant compensating use of electricity in industry for civilian goods production to make up for





Energy Sales by Classes of Consumers, 1944



Revenue by Classes of Consumers, 1944

the decline in use for war production. This accounts partly for the steep difference between the 20.7 and 6.7 percent increases in large light and power sales in 1943 and 1944. Probably the largest contributor to the difference between the two increases is the reduction in amount of electricity sold for aluminum and magnesium production that occurred in 1944.

The fact that the increase in sales to residential customers was more in 1944 (8.1 percent) than in 1943 (6.3 percent) is partly explained by the larger increase (1.8 percent) in number of these customers in 1944 than in 1943 (0.9 percent). But mostly the cause is to be seen in the greater use of electricity in homes, 1,140 kw.-hr. average annual use per residential customer in 1944 as against 1,070 kw.-hr. in 1943.

This increase in average annual use (see page 99) of 70 kw.-hr. is rather remarkable. Since 1930 that increase has been exceeded only once, from 1936 to 1937 when the jump was 78 kw.-hr. For all other years of the period the record shows increases considerably less than 70 kw.-hr. The only explanation for the large increase in 1944 is that people are staying at home more. Efforts to keep appliances in repair so industriously forwarded by the utilities during the war years might have been credited for holding the line if there had been no increase, but hardly can they have resulted in an outstanding increase. And there were no sales of appliances to boost the average use of the residential customers.

Probably the lifting of the dimout in the fall of 1943 can be said to have been responsible in some measure for the fact that small light and power customers increased their use of electricity more rapidly in 1944 (5.4 percent) than in 1943 (3.2 percent). But only coastal cities were affected by the dimout and it does not seem reasonable that its lifting in these cities could have had so great result in the national figures. It is more likely that the increase in usage by these customers is related to an increase in retail trade in 1944.

Energy Sales to Ultimate Consumers

(In Millions of Kw.-Hr.)

Year	Rural	Residential	Small Light and Power	Large Light and Power	Street and Highway Lighting	Street and Interurban Electric Railways	Electrified Divisions of Steam Railroads	Municipal and Miscellaneous	Total to Ultimate Consumers
1931	1,879	11,373	13,544	3 ,937	2,330	4,549	626	664	71,902
1932	1,579	11,494	12,106	30,965	2,033	4,040	568	926	63,711
1933	1,633	11,358	11,589	33,857	1,893	3,991	668	927	65,916
1934	1,858	12,233	12,278	36,943	1,896	4,237	692	945	71,082
1935	1,693	13,496	13,588	40,864	2,078	4,194	841	842	77,596
1936	2,138	14,992	15,612	48,655	2,223	4,401	1,115	908	90,044
1937†	1,670	17,691	18,075	51,360	1,863	4,428	1,284	2,987	99,359
1938	1,577	19,371	19,137	43,140	1,929	3,989	1,449	3,138	93,731
1939	1,881	21,084	20,722	51,108	2,002	3,918	1,847	3,205	105,768
1940	1,991	23,318	22,373	59,557	2,048	3,974	1,935	3,447	118,643
1941	2,352	25,124	24,628	76,060	2,111	3,960	2,118	3,707	140,060
1942	2,890	26,937	27,234	88,378	2,061	4,256	2,372	5,280	159,408
1943	2,996	28,621	28,192	106,657	2,075	4,696	2,530	10,122	185,889
1944*	3,300	31,050	29,700	113,800	2,170	4,625	2,675	10,275	197,600

Source: Edison Electric Institute. * Estimated. † Revised figures to conform with Uniform System of Accounts prescribed by Federal Power Commission from 1937.

$3,250,000,000

REVENUE

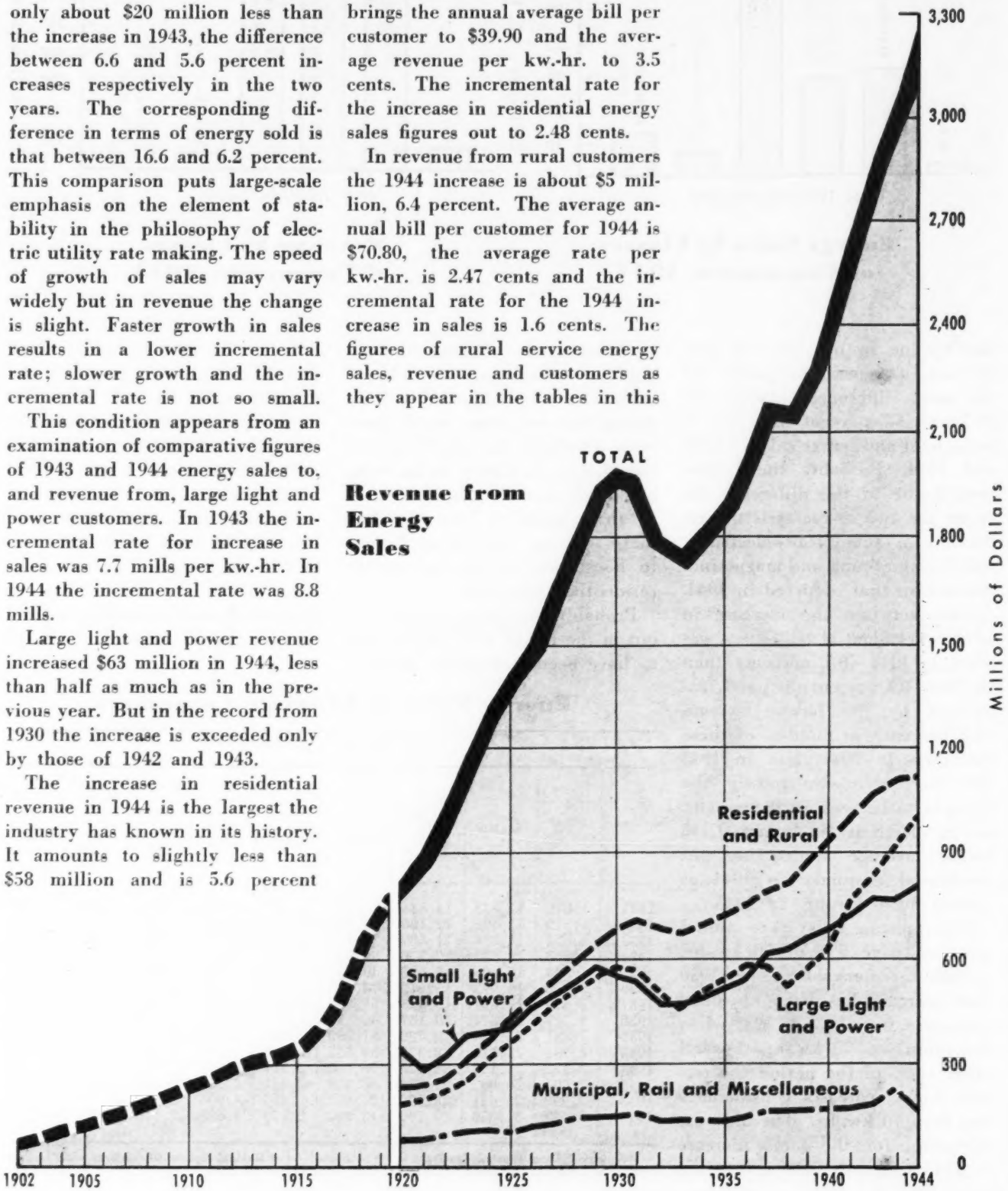
Increase in revenue in 1944 is only about $20 million less than the increase in 1943, the difference between 6.6 and 5.6 percent increases respectively in the two years. The corresponding difference in terms of energy sold is that between 16.6 and 6.2 percent. This comparison puts large-scale emphasis on the element of stability in the philosophy of electric utility rate making. The speed of growth of sales may vary widely but in revenue the change is slight. Faster growth in sales results in a lower incremental rate; slower growth and the incremental rate is not so small.

This condition appears from an examination of comparative figures of 1943 and 1944 energy sales to, and revenue from, large light and power customers. In 1943 the incremental rate for increase in sales was 7.7 mills per kw.-hr. In 1944 the incremental rate was 8.8 mills.

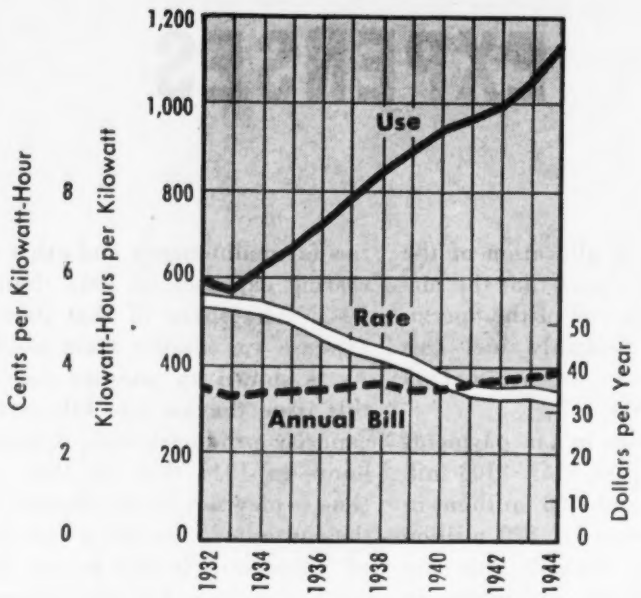
Large light and power revenue increased $63 million in 1944, less than half as much as in the previous year. But in the record from 1930 the increase is exceeded only by those of 1942 and 1943.

The increase in residential revenue in 1944 is the largest the industry has known in its history. It amounts to slightly less than $58 million and is 5.6 percent higher than in 1943. The increase brings the annual average bill per customer to $39.90 and the average revenue per kw.-hr. to 3.5 cents. The incremental rate for the increase in residential energy sales figures out to 2.48 cents.

In revenue from rural customers the 1944 increase is about $5 million, 6.4 percent. The average annual bill per customer for 1944 is $70.80, the average rate per kw.-hr. is 2.47 cents and the incremental rate for the 1944 increase in sales is 1.6 cents. The figures of rural service energy sales, revenue and customers as they appear in the tables in this



Averages for Residential Service



Residential Service to Urban and Non-Farm Homes

Year	Kw.-Hr. per Customer	Average Annual Bill (Dollars)	Revenue per Kw.-Hr. (Cents)
1932	597	33.25	5.57
1933	600	33.12	5.52
1934	624	33.07	5.30
1935	672	33.53	4.99
1936	727	33.81	4.65
1937	805	34.62	4.30
1938	853	35.31	4.14
1939	897	35.88	4.00
1940	952	36.56	3.84
1941	986	36.78	3.73
1942	1,012	37.51	3.67
1943	1,070	38.50	3.60
1944*	1,140	39.90	3.50

Source: Edison Electric Institute. *Estimated.

and other sections of this number of ELECTRICAL WORLD are admittedly not accurate as is explained in the discussion in the section devoted to customers. However, since customers are reported, energy is metered and bills are rendered on the basis of "distinct rural rates", the figures are in correct relation to each other. Therefore the average annual bill, average energy usage and incremental rate, being ratios, may be taken in fair confidence that they represent rural service conditions.

Although it shows a slight increase, a little over $2 million, 2.8 percent, over 1943, revenue from street and highway lighting still has a long way to go before it gets back to the level of the early thirties. The same thing is true of energy sales for this use. The record shows this class of business slowly recovering from the beating it took during the depression years and then the war giving it another setback. The fact that revenue in this classification turned from a decrease in 1943 to an increase in 1944 may, perhaps, be taken as an encouraging indication that plans for post-war improvements in street lighting will accomplish real results.

Corroboration of the impression that one gets from reading ODT statements in the newspapers, the impression that people are traveling too much, is to be taken from the figures of revenue from electrified divisions of steam railroads. The rate of increase in revenue from this class of business continues at a fairly high level, 8.3 percent in 1943 and 8.5 percent in 1944. Contrasted with this is the situation as regards revenue from street and interurban electric railways. Here is seen a distinct slowing-up in rate of increase; 8.3 percent in 1943 drops to 0.6 percent in 1944.

Revenue from Electricity Sales

(In Thousands of Dollars)

Year	Rural‡	Residential	Small Light and Power	Large Light and Power	Street and Highway Lighting	Street and Interurban Electric Railways	Electrified Divisions of Steam Railroads	Municipal and Miscellaneous	Total from Ultimate Consumers
1931	50,726	653,282	564,523	544,728	99,298	41,912	6,725	14,746	1,975,944
1932	47,127	640,381	500,993	474,424	89,828	36,701	6,181	18,076	1,813,717
1933	46,501	623,797	471,780	468,389	83,097	35,098	6,658	19,243	1,754,366
1934	49,182	648,801	490,420	499,451	81,846	36,402	6,680	19,085	1,831,870
1935	48,404	673,526	519,213	531,106	79,429	36,431	7,944	15,933	1,911,988
1936	59,286	696,997	562,122	581,148	80,791	37,423	9,591	17,225	2,044,586
1937†	37,726	759,824	616,438	583,197	72,740	37,019	10,761	43,091	2,160,798
1938†	38,928	802,532	632,091	518,694	74,323	33,512	11,995	44,504	2,156,580
1939†	45,484	843,158	660,683	572,659	75,443	32,573	14,427	45,154	2,289,583
1940†	49,473	895,951	689,253	631,428	76,052	32,740	15,068	50,252	2,440,218
1941	64,396	938,229	725,117	758,083	76,949	32,471	16,474	53,338	2,665,057
1942	75,027	990,185	767,279	828,318	75,660	35,343	18,289	65,742	2,885,843
1943	76,617	1,029,260	769,490	968,378	75,384	38,278	19,820	100,415	3,077,643
1944*	81,500	1,087,000	810,000	1,031,000	77,500	38,500	21,500	103,000	3,250,000

Source: Edison Electric Institute. * Estimated. † Uniform System of Accounts prescribed by Federal Power Commission begins new series of figures in 1937. ‡ Specific rural rates only.

Taking Larger Share of Revenue

EXPENSES

As was the case in 1943, operating expenditures of the electric utility industry continued in 1944 to climb faster than operating revenue. In the former year expenditures rose from $1 billion to $1.13 billion, 12.5 percent. The rise was less rapid in 1944. 8.2 percent from $1.13 billion to $1.22 billion. Revenue also rose less rapidly in 1944 than in 1943, 3.9 percent from $2.8 billion to $2.9 billion as against 7.9 percent from $2.6 billion to $2.8 billion.

Operating ratios keep on going up. They stood in 1944 at 41.7 and 65.6 percent before and after taxes as averages for the power companies of the nation. Inspection of the pie chart of allocation of the revenue dollar shows that the major factor in the rise of the operating ratios is probably fuel cost which was 10.8 percent in 1943 and 13.7 in 1944.

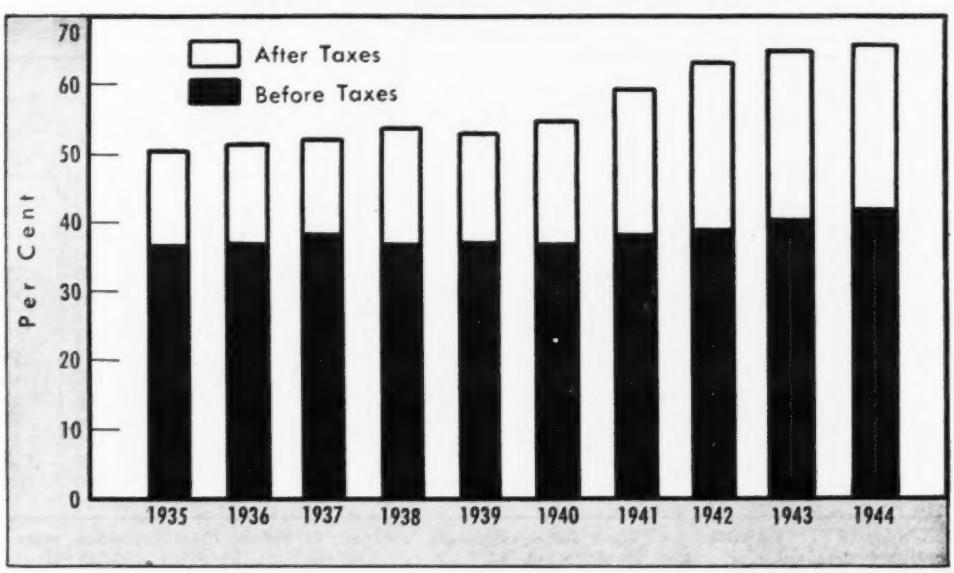
After increases in tax payments of $116 million in 1941, $108 million in 1942 and $58 million in 1943, the increase of $20 million in 1944 seems small. This undoubtedly welcome slowing-up in the rate of tax rise still leaves taxes taking 23.9 cents out of the revenue dollar, nearly twice as much as the 12.9 cents for salaries and wages.

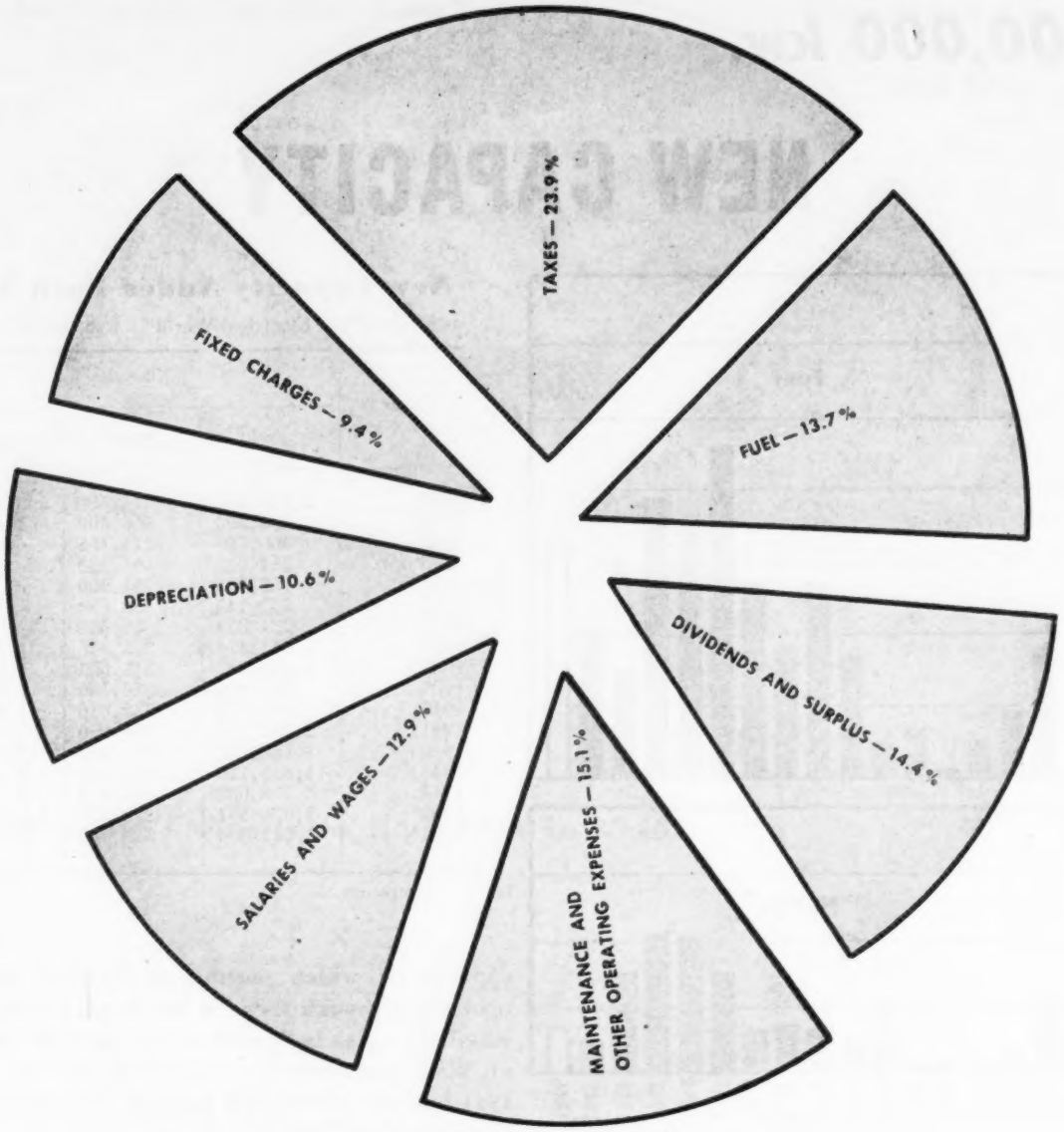
A lesser proportion of the revenue dollar was used by the utilities for maintenance and other operating expenses in 1943 than in 1942. The share to that item of expense was smaller again in 1944. As is shown on another page of this issue the average kilowatt of capacity produced more kilowatt-hours in 1944 than in 1943 and thus it may not be concluded that the continued decrease in this item of proportion is due to any lessened necessity for maintenance. Rather it must be accepted that difficulties in obtaining labor and repair materials and parts still beset the industry. What this condition will mean when the demands of war subside is indicated on page 108.

Operating Ratio Before and After Taxes

Electric Utility Companies

	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944
Before Taxes..	36.9	37.3	38.5	37.3	37.4	37.5	38.4	38.7	40.0	41.7
After Taxes...	50.9	52.2	53.8	54.2	53.3	55.3	59.4	62.9	64.2	65.6




TAXES — 23.9%
FUEL — 13.7%
DIVIDENDS AND SURPLUS — 14.4%
MAINTENANCE AND OTHER OPERATING EXPENSES — 15.1%
SALARIES AND WAGES — 12.9%
DEPRECIATION — 10.6%
FIXED CHARGES — 9.4%

Allocation of Electricity Sales Revenue Dollar, 1944

The pie chart in last year's statistical number showed that the electricity sales revenue dollar in 1943 was cut up into the following pieces: Taxes, 25.2 cents; fuel, 10.8 cents; dividends and surplus, 14.4 cents; maintenance and other operating expenses, 16.1 cents; salaries and wages, 13.4 cents; depreciation, 11.0 cents; fixed charges, 9.1 cents.

Only two of the slices were larger in 1944 than in 1943, fixed charges by 0.3 cents and fuel by 2.9 cents. All the others were smaller except dividends and surplus which remained unchanged. The increase of 2.9 cents in the share taken by fuel is a partially result of increased output from fuel burning plants. In 1944 the average output per unit of combined fuel and water power capacity was slightly more than in 1943. This increase, plus the amount of a decrease in output from water power, came from fuel burning plants. The increased output from fuel was 2.6 percent, which checks pretty closely with the increased proportion of fuel cost in the revenue dollar.

Operating Revenue, Expenditures, Taxes

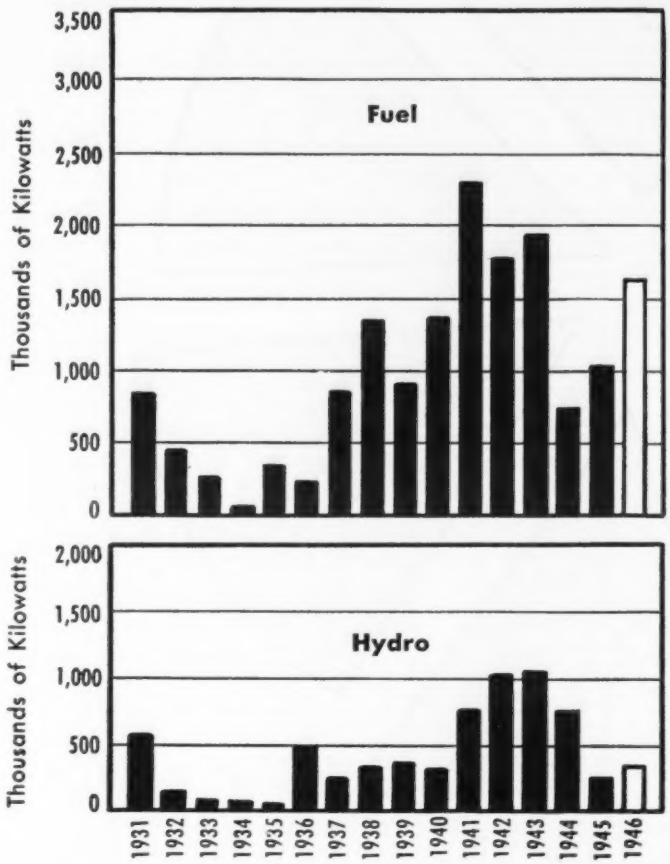
Privately Owned Establishments*
(In Millions of Dollars)

Year	Operating Revenue	Operating Expenditures	Taxes
1935.....	1,785	669	251
1936.....	1,911	721	281
1937.....	2,031	781	308
1938.....	2,018	762	323
1939.....	2,148	798	352
1940.....	2,277	863	404
1941.....	2,467	947	520
1942.....	2,609	1,002	628
1943.....	2,816	1,127	680
1944*.....	2,926	1,219	700

Source: Edison Electric Institute.
* Date adjusted to cover only utilities operating as private enterprises on December 31, 1941.
† Subject to year-end revisions.

4,800,000 kw.

NEW CAPACITY



New Capacity Added Each Year

as reported to "Electrical World" for the entire industry

Year	Kilowatts		
	Fuel	Hydro	Total
1930	2,040,947	748,480	2,789,427
1931	836,500	566,500	1,403,000
1932	466,300	126,155	592,455
1933	251,025	95,325	346,350
1934	52,805	41,900	94,705
1935	347,140	38,950	386,090
1936	231,828	489,865	721,093
1937	873,414	245,346	1,118,760
1938	1,350,303	345,605	1,695,808
1939	914,680	370,150	1,284,830
1940	1,361,094	332,016	1,693,110
1941	2,292,215	786,250	3,078,375
1942	1,756,212	1,026,900	2,783,112
1943	1,835,180	1,088,900	2,924,080
1944	778,037	767,855	1,545,892
1945*	1,026,551	270,500	1,297,051
1946*	1,632,854	328,000	1,960,854

* Prospective.

Additions to power generating capacity continue to be a matter of Federal priority and allocation. Neither the industry in private hands nor that part under governmental direction is a completely free agent in deciding what additions to make or plan in order to render the overall facilities comfortably capable of handling the demands imposed.

Actually added to the systems during 1944 there have been 1,545,892 kw. comprising 764,050 kw. of steam generating capacity and 767,855 kw. of hydro capacity of which most is in Federal government projects, although there is one large power company installation. As indicated a year ago, the early plans of WPB provided for a 500,000 kw. increment in 1944 but the liberalized program has resulted in an additional million.

The electric utility industry is looking confidently ahead, if its program for station additions for 1945 and particularly its plans for 1946 and beyond are taken at face value. The present year will witness an addition of over 1,000,000 kw. and that is nearly four times what the managements were ready to vouchsafe a year ago. This in turn is double the 500,000 kw. scheduled by WPB when it laid down the war-duration schedule. For the years immediately following, the industry has projected an increment of 1,960,854 kw.

Kw. Totals for 1944, 1945, 1946 and Later

Kind of Power	Private Companies	Government Power	Totals
Steam	760,050	4,000	764,050
Hydro	131,355	636,500	767,855
Int. Com.	5,460	8,527	13,987
Totals	896,865	649,027	1,545,892

Kind of Power	Private Companies	Government Power	Totals
Steam	887,000	104,000	991,000
Hydro	5,000	265,500	270,500
Int. Com.	4,055	31,496	35,551
Total	896,055	400,996	1,297,051

Kind of Power	Private Companies	Government Power	Totals*
Steam	1,305,250	318,000	1,623,250
Hydro	13,000	315,000	328,000
Int. Com.	4,604	5,000	9,604
Totals	1,322,854	638,000	1,960,854

Generating Capacity Added in 1944

Steam

Private Companies	*Kw. (Nameplate)*
Alabama Power Co.	60,000
Appalachian Electric Power Co.	80,000
Consolidated Gas, Electric Light & Power Co. of Baltimore	50,000
Dayton Power & Light Co.	30,000
Florida Power Corp.	25,000
Gulf Power Co.	22,500
Indiana & Michigan Electric Co.	85,000
Iowa Electric Light & Power Co.	15,000
Mountain States Power Co.	3,750
Natrona Light & Power Co.	5,000
New Hampshire Gas & Electric Co.	7,500
New York State Electric & Gas Corp.	35,000
Northern States Power Co.	50,000
Ohio River Power Co.	50,000
Pennsylvania Edison Co.	25,000
Pennsylvania Electric Co.	25,000
Public Service Co. of Indiana, Inc.	87,500
Metropolitan Edison Co.	16,800
Southern Indiana Gas & Electric Co.	20,000
Southwestern Gas & Electric Co.	6,000
Southwestern Public Service Co.	2,500
Tampa Electric Co.	2,500
Virginia Electric & Power Co.	56,000
Total	760,050
Municipal and Other Public Plants	
Dairyland Power Cooperative	4,000

Hydro

Private Companies	
Appalachian Electric Power Co.	765
Central Vermont Public Service Corp.	1,000
Idaho Power Co.	1,590
Pacific Gas & Electric Co.	128,000
Total	131,355
Municipal and Other Public Plants	
Bureau of Reclamation	340,500
Tacoma, Wash.	40,000
Tennessee Valley Authority	186,000
U. S. Engineers	70,000
Total	636,500

Internal Combustion

Private Companies	
Arizona General Utilities Co.	500
Community Public Service Co.	1,000
Consumers Public Service Co.	175
Idaho Power Co.	211
Iowa Public Service Co.	1,125
Kansas Power Co.	1,350
Louisiana Public Utilities Co.	75
Northwestern Light & Power Co.	700
Southwestern Public Service Co.	102
Tilden Electric Light & Power Co.	118
Texas Electric Service Co.	104
Total	5,460
Municipal and Other Public Plants	
Barron, Wisc.	980
Bethany, Missouri	750
Braham, Minn.	1,125
Bryan, Texas	700
Coon Rapids, Iowa	700
Corning, Iowa	690
Howard, S. Dakota	300
Johnson, Kansas	112
Julesburg, Colorado	300
Mora, Minn.	690
Newton Falls, Ohio	300
Vevay, Indiana	150
Wells, Minn.	980
Total	8,527

Generating Capacity to Be Added in 1945

Steam

Private Companies	*Kw. (Nameplate)*
Boston Edison Co.	50,000
Central States Electric Co.	7,500
Cities Service Power and Light System	12,500
Consolidated Edison Co. of N. Y. Inc.	72,500
Dallas Power and Light Co.	30,000
Eastern Shore Public Service Co. of Maryland	7,500
Georgia Power Co.	60,000
Illinois Northern Utilities Co.	50,000
Indiana General Service Co.	100,000
Iowa Electric Light and Power Co.	10,000
Iowa-Illinois Gas and Electric Co.	5,000
Iowa Public Service Co.	10,500
Long Island Lighting Co.	50,000
Lynn Gas and Electric Co.	10,000
Mississippi Power Co.	22,500
Missouri Utilities Co.	5,000
New York State Electric and Gas Corp.	30,000
Ohio Power Co.	100,000
Pennsylvania Electric Co.	4,000
Northwestern Public Service Co.	7,500
Potomac Electric Power Co.	50,000
Produce Terminal Co.	10,000
Public Service Co. of Indiana	50,000
Public Service Co. of Oklahoma	25,000
Southera Utah Power Co.	2,500
Southwestern Public Service Co.	25,000
Tampa Electric Co.	15,000
West Penn Power Co.	65,000
Total	887,000
Municipal and Other Public Plants	
Colorado Springs, Colorado	5,000
Fairmont, Minn.	4,000
Flora, Ill.	2,000
Marshfield, Wisc.	4,000
San Antonio, Texas	25,000
Sheridan County Electric Co.	4,000
Tennessee Valley Authority	60,000
Total	104,000

Hydro

Private Companies	
Central Vermont Public Service Corp.	5,000
Municipal and Other Public Plants	
Bureau of Reclamation	1,500
Tacoma, Washington	65,000
Tennessee Valley Authority	199,000
Total	265,500

Internal Combusition

Private Companies	
Calif.-Pacific Utilities Co.	800
Emmons County Light & Power Co.	200
Inland Utilities Co.	530
Iowa Public Service Co.	1,125
Louisiana Public Utilities Co.	1,000
Missouri Gas & Electric Service Co.	200
Texas Electric Service Co.	200
Total	4,055
Municipal and Other Public Plants	
Belhaven, N. C.	200
Belzoni, Miss.	480
Benton, Ark.	980
Bloomfield, Iowa	300
Bountiful, Utah	700
Broken Bow, Neb.	1,000
Bryant, S. D.	200
Carthage, Mo.	2,250
Clayton, New Mexico	300
Consumers Public Power District	2,000
Delta, Colo.	980
Dowagiac, Mich.	980
Estelline, S. D.	200
Falls City, Neb.	1,000
Hatfield, Pa.	300
Higginsville, Mo.	800
Holland, Mich.	2,500
Janesville, Minn.	300
Jonesville, La.	160
Kennett, Mo.	856
Mangum, Okla.	1,200
Melrose, Minn.	980
Monroe City, Missouri	725
Mulvane, Kans.	300
New Prague, Minn.	560
Ninnketa Power Coop, Inc., N. D.	1,000
O and A Electric Coop.	300
Paulding, Ohio	500
Prentiss, Miss.	480
Red Cloud, Neb.	200
Sac County Electric Co.	700
Sikeston, Mo.	2,250
Springfield, Minn.	700
Sulphur Springs Valley Electric Coop.	640
Terrell, Texas	840
Thayer, Mo.	300
Trenton, Mo.	980
Tri-County Electric Coop.	1,125
Weatherford, Texas	980
Whitesboro, Tex.	250
Total	31,496

Generating Capacity to Be Added in 1946 and Later

Steam

Private Companies	*Kw. (Nameplate)*
Alabama Power Co.	25,000
Atlantic City Electric Co.	*25,000
Arizona Electric Power Corp.	750
Arkansas Power and Light Co.	30,000
Central Illinois Public Service	50,000
Central Ohio Light and Power Co.	15,000
Central Power and Light Co.	30,000
Connecticut Light and Power	45,000
Consolidated Edison Co. of N. Y. Inc.	50,000
Dayton Power and Light Co.	50,000
Detroit Edison Co.	75,000
Duke Power Co.	40,000
El Paso Electric Co.	12,000
Florida Power Corp.	25,000
Florida Power & Light Co.	*35,000
Houston Light and Power Co.	37,500
Illinois Power Co.	80,000
Indianapolis Power and Light Co.	37,500
Interstate Power Co.	*15,000
Iowa-Illinois Gas and Electric Co.	35,000
Iowa Southern Utilities Co.	15,000
New England Gas and Electric	35,000
Philadelphia Electric Co.	*150,000
Pennsylvania Electric Co.	35,000
Oklahoma Gas and Electric Co.	10,000
Otter Tail Power Co.	10,000
Potomac Edison Co.	30,000
Southwestern Gas & Electric Co.	15,000
Southwestern Public Service Co.	*25,000
Staten Island Edison Co.	20,000
Tenney Companies	10,000
Tucson Gas Electric Light and Power Co.	12,500
Union Electric Co. of Missouri	90,000
Wisconsin Electric Power Co.	80,000
Wisconsin Power and Light Co.	*25,000
Wisconsin Public Service Corp.	30,000
Total	1,305,250
Municipal and Other Public Plants	
Burbank, California	10,000
Chicago (Ill.) Sanitary District	10,000
Cleveland, Ohio	75,000
Columbus, Ohio	12,500
Crawfordsville, Indiana	4,500
Glendale, California	20,000
Grand Island, Nebraska	5,000
Holyoke, Mass.	5,000
Kansas City, Kansas	30,000
Kingfisher, Okla.	4,000
Los Angeles, Calif.	65,000
Manitowoc, Wisc.	20,000
South Carolina Public Service Authority	50,000
Taunton, Mass.	10,000
Total	318,000

* These installations have already been authorized by OWU.

Hydro

Private Companies	*Kw.*
Central Vermont Public Service Corp.	3,000
Tenney Companies	10,000
Total	13,000
Municipal and Other Public Plants	
Bureau of Reclamation	190,500
Tennessee Valley Authority	99,500
City of Tacoma	25,000
Total	315,000

Internal Combustion

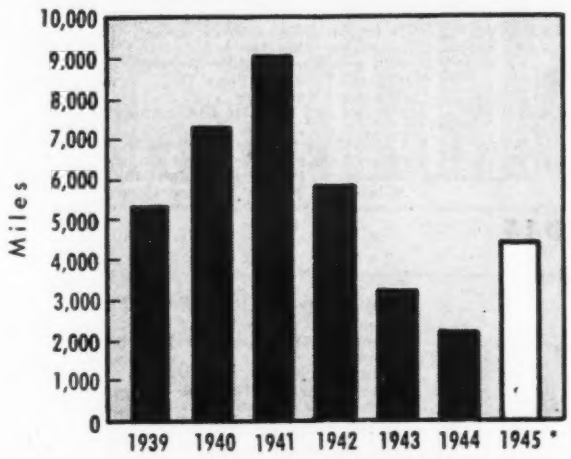
Private Companies	*Kw.*
Northwestern Public Service Co.	1,400
Oklahoma Gas & Electric Co.	704
Otter Tail Power Co.	2,500
Total	4,604
Municipal and Other Public Plants	
Bath, N. Y.	1,000
Consumers Public Service Power District	4,000
Total	5,000

2,200 Miles; 2,411,000 kva.

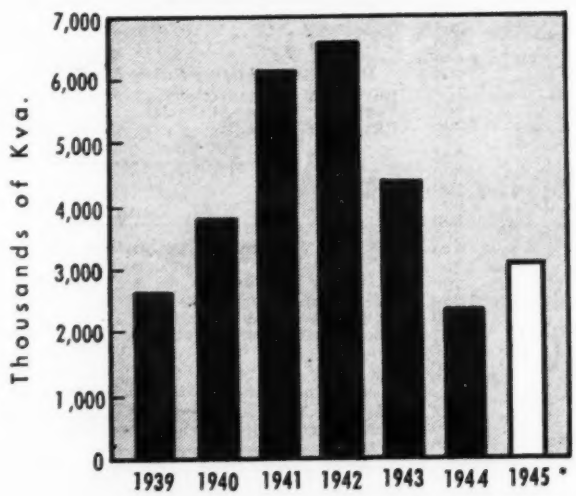
TRANSMISSION AND SUBSTATIONS

Stringencies on materials in 1944 held the added transmission mileages and substation capacities to considerably less than the 1943 increments and to some 40 percent of the 1942 values. However, the magnitudes scheduled for completion in 1945 are double in the case of transmission and up a third in substation commitment. For the year after (1946) and beyond serious consideration is already being given to transmission mileage 50 percent greater than was added in 1944 and even to substation capacity up to three-quarters of the amount just added.

New Transmission Lines



New Substation Capacity



Construction of Transmission

(In Miles—11 Kv. and Up)

Region	1941	1942	1943	1944	1945*
New England	298	131	43	34	64
Middle Atlantic	925	618	232	149	364
East North Central	1,065	914	467	248	308
West North Central	456	645	308	178	692
South Atlantic	1,670	960	800	378	914
East South Central	690	698	206	355	490
West South Central	1,306	846	550	389	802
Mountain	952	335	321	70	324
Pacific	1,724	742	366	413	536
United States	9,086	5,889	3,293	2,214	4,494

Source: "Electrical World" Surveys. * Estimated.

Construction of Substations

(In Thousands of Kva.)

Region	1941	1942	1943	1944	1945*
New England	346	65	208	22	154
Middle Atlantic	1,442	597	460	221	224
East North Central	1,152	1,802	1,067	390	743
West North Central	297	833	443	72	193
South Atlantic	782	797	340	223	370
East South Central	592	1,293	868	377	406
West South Central	233	390	277	165	217
Mountain	212	67	139	18	34
Pacific	1,166	746	579	923	789
United States	6,222	6,590	4,381	2,411	3,130

Source: "Electrical World" Surveys. * Estimated.

42,000 Miles, $48 Million

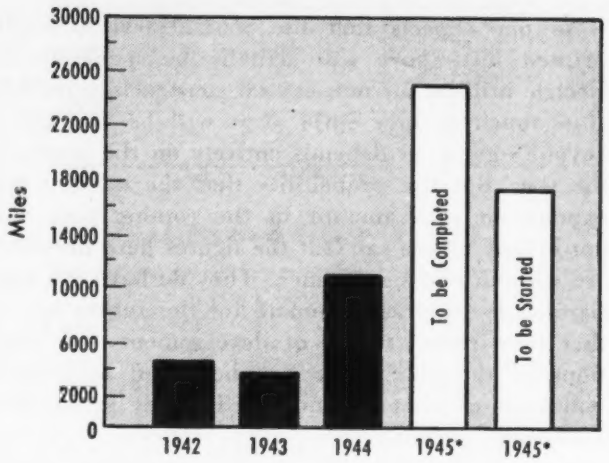
RURAL LINES

Miles of Rural Line Extensions

As reported to "Electrical World"

Regions	1942	1943	1944	1945*	1945†
New England	150	72	196	1,282	563
Middle Atlantic	163	642	3,160	5,524	3,182
East North Central	638	1,073	2,065	3,666	2,898
West North Central	484	614	1,724	2,360	736
South Atlantic	906	321	473	2,898	3,752
East South Central	222	98	301	2,767	2,810
West South Central	592	490	1,992	4,840	2,900
Mountain	501	106	180	446	335
Pacific	1,004	546	842	1,251	315
United States	4,660	3,962	10,933	25,034	17,491

* Estimated construction to be completed in 1945.
† Estimated construction to be started in 1945.



Rural line construction in 1944 among the utilities was roughly two and a half times as active, measured in miles of line, as it was on the average for 1942-43. And even more indicative of a determination to serve rural customers reachable by utility systems is the fact that more than 25,000 miles are already projected for installation in 1945. One can add to this the 17,500 miles scheduled to be initiated (if not completed) in the present year. Lumping the two values together there results 42,000 miles, a figure which quadruples the 1944 activity and outdoes 1943 by more than tenfold.

Meanwhile, the budgeted expenditures for 1945 are estimated at practically $48,000,000, nearly double those similarly computed for 1944. These estimates are based on returns from utilities that constitute about 70 percent of the national generating capacity; regionally the percentage of returns deviate both sides of this average. No attempt should be made to reconcile these expenditure figures with those for mileage (at least not for deriving a dollars-per-mile average) because the mileage figures represent an average 90 percent sampling and were obtained somewhat earlier than the budget information.

Regionally the East South Central area is making the largest projected increase — a nine-fold one—in mileage. Next in order fall the New England and South Atlantic regions with step-ups of 6.55 and 6.15 times respectively. Other regions run close to a doubling on the average.

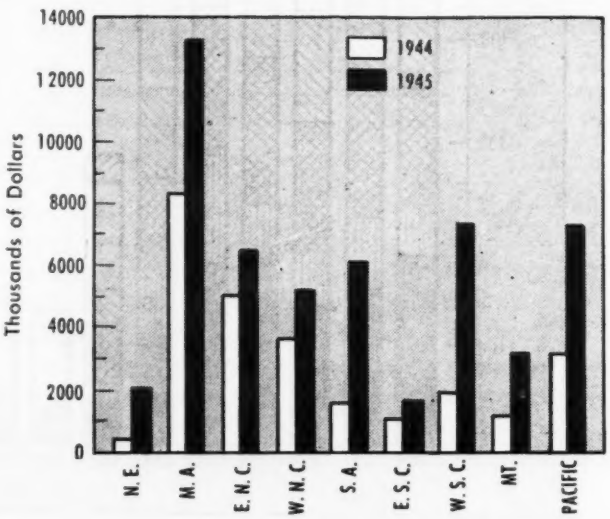
In terms of dollar outlay the New England and Middle Atlantic areas offer the largest opportunity for new line material sales; between them they will contribute nearly $6,500,000 more than was expended on rural line construction in 1944.

Rural Line Construction Expenditures

As Reported to "Electrical World"

Regions	1944	1945*
New England	446,000	2,019,000
Middle Atlantic	8,441,000	13,278,000
E. N. Central	5,078,000	6,577,000
W. N. Central	3,632,000	5,200,000
South Atlantic	1,785,000	6,242,000
E. S. Central	1,048,000	1,676,000
W. S. Central	1,973,000	7,350,000
Mountain	1,200,000	3,210,000
Pacific	3,237,000	7,353,000
United States	26,840,000	47,905,000

* Estimated.



$663,297,000

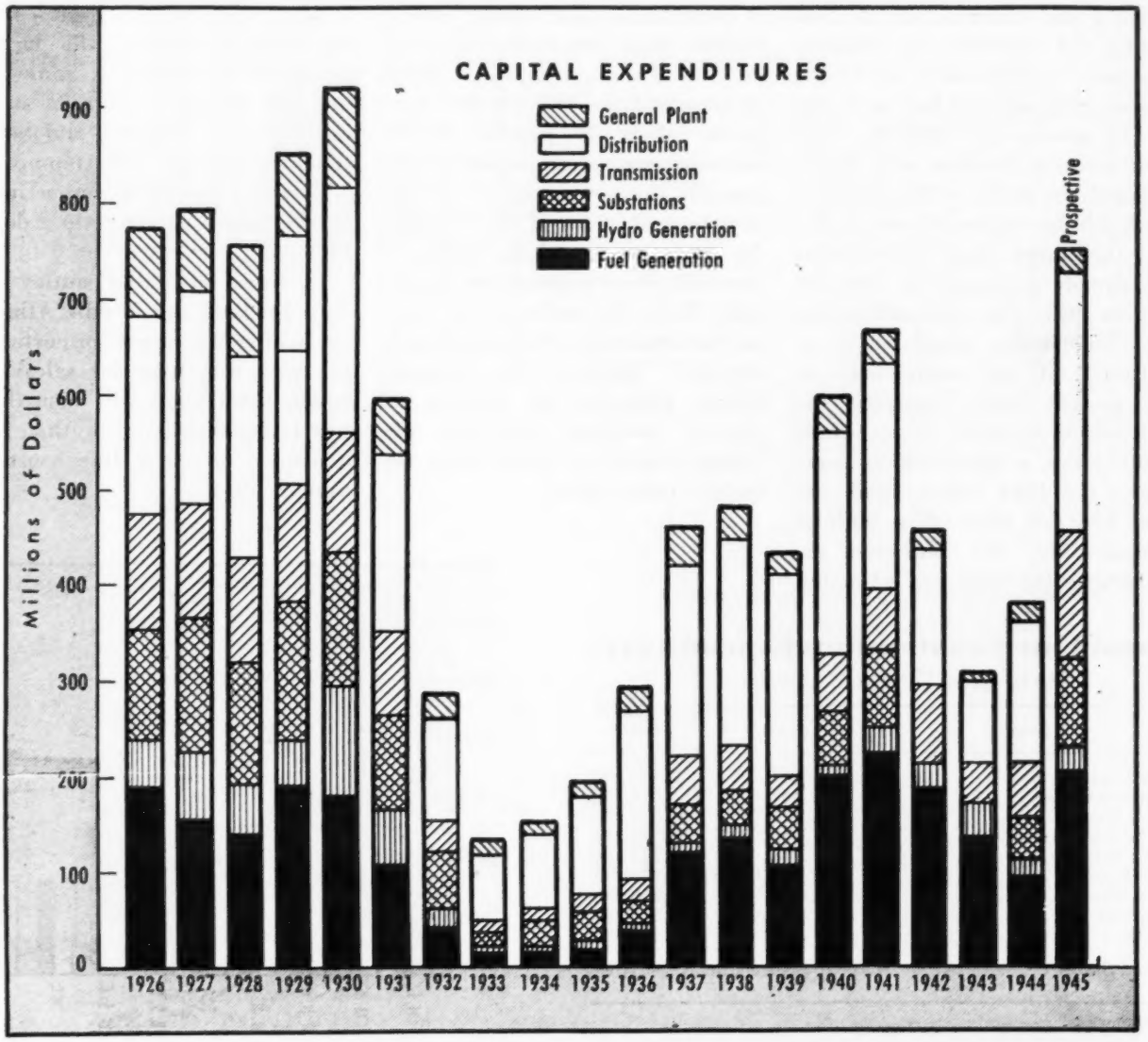
BUDGET

No one expects that the $663,297,000 so boldly printed just above will actually be spent by the electric utilities for new capital construction in 1945. How much or how little of it will be laid out is anyone's guess: it depends entirely on the course of the war. But the probability that the utilities will expend no such amount in the coming year does not by any means say that the figures here presented are without real significance. They do have the same significance that any estimate for the future has, in that they reveal trends of development and directions of thought. They can be taken as reliable indicators of what the industry is ready to do when conditions permit.

In the sense, then, as indicators, these figures of "contemplated" 1945 expenditures may be examined to see what they disclose.

First off, the total of $663 million plus is the second highest in the history of the industry. It is exceeded only by the $919 million that was put into new construction 15 years ago in 1930. That was when the President of the United States called upon the light and power companies not to reduce, but instead to enlarge, their construction programs in an effort to stem the tide of depression then beginning.

By the time that the budget that will supersede the one presented here is announced, there will have accumulated a greater need for new construction



than exists now. Therefore it can be expected that future total of contemplated expenditures will be closer to, or perhaps equal or even surpass, the historic peak of 1930 construction.

Another meaningful indicator is the fact that the 1945 figures for fuel and water power stations amount to about twice as much as those for 1944. This is a plain evidence that those prophets are mistaken who assert the industry will be plagued with a great excess of generating capacity when the war is over. A glance at the figures of new capacity to be installed in 1946 and later on page 102 corroborate this evidence if corroboration is needed.

In 1944 the largest single item of expenditure was for distribution plant, nearly 45 percent of the total. For 1945 distribution appears again as the largest item although slightly smaller in ratio, about 41 percent. In the years 1942 and 1943 distribution construction was rigorously restricted by copper and other war scarcities. Then in 1944 these scarcities were considerably overcome with the result that distribution moved strongly up in expenditure allocations. Probably the actuality of 1945 will show it down again to the range of 1942 and 1943. But the "contemplated" figure for 1945 indicates how important distribution will become in the utility construction picture as soon as war restrictions are relaxed or removed.

Transmission shows a large jump from 1944; it more than doubles to the estimate for 1945. From this it may be assumed that interconnection of systems, far as it has been carried as a means for complete utilization of generating plant capacity during the war years, has not yet reached its full potentialities by any means.

The expenditure figures presented here are for utilities, including municipal, that serve the public directly. They do not include REA cooperatives or federal power projects. Information on the expenditures of these undertakings is not available in definitive terms, but from data at hand it may be guessed that their budgets for 1945 would be around $150 million. Thus, if V-E Day had come in 1944 as was so confidently expected, the 1945 expanded budget might now easily have been over $800 million.

Capital Expenditures, 1944

As Reported to "Electrical World" (In Thousands of Dollars)

Regions	Fuel Stations	Hydro Stations	Transmission Plant	Distribution Plant	General Plant	Total Plant	Substations*
N.E.	5,956	1,154	1,941	4,028	404	13,483	1,028
M.A.	28,545	508	10,292	42,800	5,139	87,284	6,957
E.N.C.	24,988	165	12,367	27,272	2,012	66,804	6,580
W.N.C.	7,267	288	4,523	9,520	573	22,171	3,575
S.A.	12,635	77	6,231	12,285	1,119	32,347	4,438
E.S.C.	6,331	600	8,754	8,081	198	23,964	1,461
W.S.E.	6,236	13	3,788	13,801	420	24,258	3,908
Mountain	1,281	311	1,800	6,691	335	10,418	1,196
Pacific	2,887	16,772	11,500	27,491	905	59,555	11,520
Total	96,126	19,888	61,196	151,969	11,105	340,284	40,663

Prospective Capital Expenditures, 1945

N.E.	10,722	1,945	7,728	13,306	996	34,697	3,846
M.A.	73,606	1,911	27,088	70,378	10,031	183,017	20,957
E.N.C.	48,485	182	29,200	50,020	5,168	133,055	18,823
W.N.C.	18,489	1,465	12,873	18,143	2,559	53,529	6,365
S.A.	21,397	766	16,022	24,139	2,625	64,949	12,646
E.S.C.	4,716	251	5,713	18,495	468	29,643	2,311
W.S.C.	14,720	.....	10,696	20,556	1,712	47,684	5,828
Mountain	3,770	1,674	4,063	14,563	670	24,740	2,821
Pacific	5,026	19,017	20,154	44,857	2,929	91,983	19,042
Totals	200,931	27,214	133,537	274,457	27,158	663,297	92,639

*Substation expenditures are included in those for transmission and distribution plant.

Annual Capital Expenditures for New Construction

Electric Light and Power Industry (In Thousands of Dollars)

Year	Fuel	Hydro	Transmission	Substations*	Distribution	General Plant	Total
1930	176,496	117,565	139,533	123,482	258,699	103,642	919,417
1931	104,386	60,317	101,031	187,564	182,158	61,284	596,740
1932	40,000	20,000	60,000	30,000	110,000	25,000	285,000
1933	10,400	4,000	16,100	14,900	72,200	11,700	129,300
1934	10,258	5,704	30,180	11,921	76,299	13,292	147,654
1935	16,172	6,337	35,349	14,766	103,104	17,127	192,855
1936	36,820	9,030	20,170	25,050	174,640	24,000	289,710
1937	113,060	10,540	40,740	49,290	203,250	38,600	455,480
1938	133,000	17,600	36,000	46,400	215,000	34,000	482,000
1939	101,500	17,900	45,500	31,750	210,500	22,850	430,000
1940	200,430	9,270	55,900	57,760	237,700	35,520	596,580
1941	219,741	27,186	62,476	79,218	232,840	32,687	654,148
1942†	191,671	22,847	85,633	.....	144,180	11,644	455,975
1943	137,059	35,505	42,923	32,740	84,683	6,066	306,286
1944	96,126	19,888	61,196	40,663	151,969	11,105	340,284
1945	200,931	27,214	133,537	92,639	274,457	27,158	663,297

*After 1941, substation expenditures, although separately stated, are included in figures for transmission and distribution.
†Expenditure study not made by "Electrical World" in 1942. Figures are those reported by Federal Power Commission for privately owned utilities only.
‡Prospective.

$268,741,000

MAINTENANCE COSTS

Expenditures by electric utilities solely for maintenance in 1945 are planned to amount to $268,741,000 —a figure 78 percent greater than the latest previous ones available, those for 1943. The intended outlay is correspondingly almost double the maintenance expenditures for 1942. Of course, how much actually is expended will depend on war developments during the year.

During the war the whole electric utility system has been worked as never before. Wear and tear and accelerated heating of insulations have been taking their toll in terms of shortened equipment life although few indeed have been the burnouts that occur when insulation life is encroached upon too much. Poles and towers, generating and sub-station facilities, automotive equipment — everything in fact — have had what care and attention could be given them in view of the limited materials and manpower. Against the day when those restrictions may be eased the industry has thus budgeted a greatly increased outlay toward putting everything back into sound condition as rapidly as possible.

Some indication of the way in which this upkeep money is likely to be allocated is found in the 1937-43 data of the Federal Power Commission. There it is shown that distribution receives 51.1 percent and the steam power plant 30.8 percent. Transmission gets 9.8 percent. In view of the constancy of proportions in recent years it is likely that they will hold fairly well for the current year. With all the newly added generating capacity there is some possibility, however, that the generation allocation may be proportionately less than in previous years.

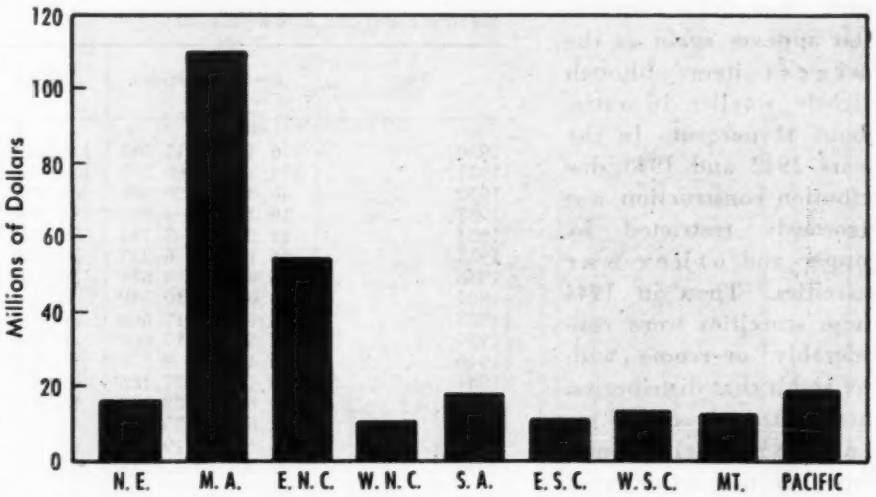
Maintenance Expenditures 1945*

As Reported to "Electrical World"

Regions	Amount
New England	$16,882,000
Middle Atlantic	110,235,000
E. N. Central	55,358,000
W. N. Central	10,618,000
South Atlantic	18,318,000
E. S. Central	11,411,000
W. S. Central	14,044,000
Mountain	12,875,000
Pacific	19,000,000
United States	268,741,000

* Estimated.

Maintenance Expenditures, 1945



Maintenance Expenditures

Privately Owned Class A and B Electric Utilities in The United States

(In Thousands of Dollars)

Production Expenses	1937	1938	1939	1940	1941	1942	1943	Totals	Percent
Steam Power	32,628	31,511	33,240	36,222	40,397	44,775	53,258	272,031	30.8
Hydraulic Power	5,524	6,192	5,985	5,995	6,369	6,152	7,955	44,172	4.6
Int. Comb. Eng. Power	723	622	659	731	702	759	809	5,005	0.5
Transmission	13,038	11,689	10,487	11,298	12,215	13,456	14,921	87,104	9.8
Distribution	62,292	62,604	62,027	63,789	65,446	66,108	69,624	451,890	51.1
General Properties	3,485	3,452	4,101	4,110	4,091	4,023	4,473	27,735	3.2
Total	117,690	116,070	116,499	122,145	129,220	135,273	151,040	887,937	100.0

Source: Federal Power Commission

Refunding Takes A Spurt

FINANCIAL

In volume of financial operations, 1944 was the biggest year for the electric utilities since 1936. Total financing in 1944 amounted to $1,018,227,630 as against $371,062,000 in 1943, an increase of 175 percent. After staying at about the same level for three consecutive years, the amount of financing suddenly shot up in 1944.

The reason is not far to seek. With national income at the highest point in history and with war's heavy hand summarily restricting the production of civilian goods, there was inevitably much money looking for places to go, over and above that channeled into war financing. Resulting from this condition was an opportunity, improved by many utilities during the year, to reduce the cost of long term debt. Refunding of bond issues, which had been declining in volume for nine years, again became a highly profitable operation.

How profitable it is appears from comparison of average yields of bonds and of preferred stocks, 2.92 and 4.09 percent respectively, with the yields for 1943, published on this page a year ago, 3.23 and 4.44 percent. On bonds the yield has dropped 3 mills on the dollar and 3½ on preferred stocks.

In 1943 new capital entering the business was about $10 million. The figure for 1944 was about 50 percent higher and, stated that way, seems quite significant. But its significance disappears when it is taken as a proportion of the total, $15,587,000 against $1,018,228,000, only about 1½ percent. Except for 1943 new capital in 1944 was the lowest in ten years. Contrasting this with the total of capital expenditures reported on page 107 of this issue emphasizes the extent to which the industry is financing its continuing expansion with internal funds.

In 1944 investors were offered 50 electric utility issues as against 28 in 1943. Of the 50, 33 were of mortgage bonds, 3 of debentures, 1 of notes, 12 of preferred stock and one of common stock. Yet, despite the much larger number of issues, the average per issue was about double what it was in 1943.

New Utility Financing Totals $1,018,227,630

No. of Issues	Range of Yield	Amount of Issues
Mortgage Bonds (Av. yield 2.92%)		
6	2.70–2.75	$206,500,000
6	2.77–2.80	341,000,000
5	2.83–2.87	135,943,000
5	2.90–2.98	100,000,000
8	3.10–3.94	148,300,000
3	.....	7,750,000
33		$939,493,000
Debentures (Av. yield 3.18%)		
2	3.00–3.25	$5,450,000
1	.....	10,000,000
3		$15,450,000
Notes		
1	.....	$750,000
Preferred Stock (Av. Yield 4.09%)		
5	3.82–3.94	$33,178,700
3	4.05–4.46	23,565,400
4	4.80–5.05	4,709,450
12		$61,453,550
Common Stock		
1	.....	$1,081,080
Total Financing	.....	**$1,018,227,630**
Refunding	.....	**1,002,640,710**
New Capital	.....	**15,586,920**

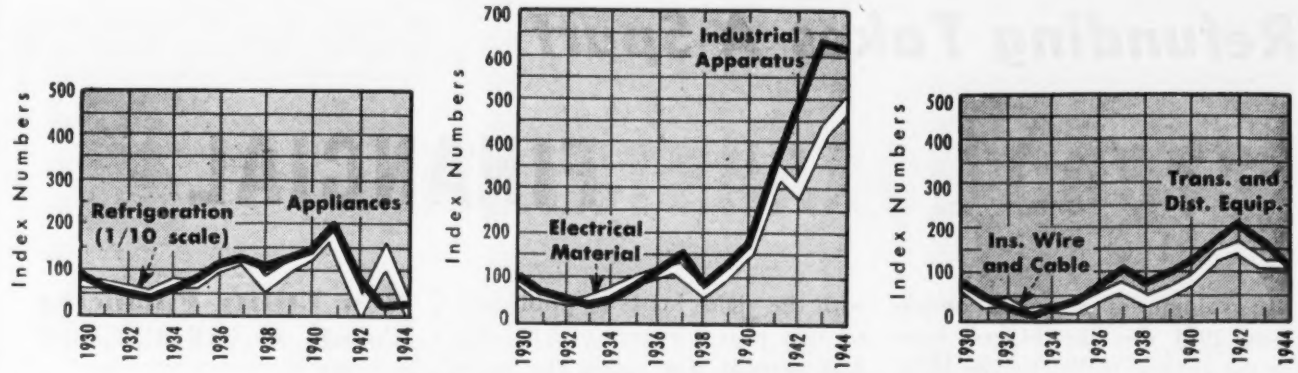
Institutional investors took a larger share, 11 percent, of bonds, debentures, etc. in 1944 than the 7½ percent to them in 1943. The $103,950,000 taken by them is a return to the level established in 1941 and 1942.

And, finally, the small and lonesome figure of $1,081,080 in a single issue of common stock is to be noted—and noted well.

Security Sales by Classes

(In Thousands of Dollars)

Year	Bonds, Debentures, etc., to		Stocks, Common and Pfd.	Total Financing	Distribution of Security Sales		
	Public Investors	Institutional Investors			New Capital	Refunding	Total Issues
1930.....	1,114,636	Included	473,218	1,587,854	894,473	403,062	1,297,535
1931.....	1,090,584	in	417,658	1,508,242	424,163	758,741	1,182,904
1932.....	404,840	Col. 1	65,417	470,257	165,728	239,112	404,840
1933.....	53,725		2,523	56,248	6,813	46,913	53,725
1934.....	131,175		.....	131,175	2,431	128,744	131,175
1935.....	957,042	110,629	8,229	1,075,900	26,496	1,049,404	1,075,900
1936.....	1,122,800	156,881	52,259	1,331,940	59,727	1,272,213	1,331,940
1937.....	522,613	37,604	86,095	646,312	81,984	563,699	645,682
1938.....	750,549	192,762	20,694	964,005	123,056	840,949	964,005
1939.....	620,205	252,625	123,517	996,347	16,219	980,128	996,347
1940.....	660,716	188,976	139,767	989,459	92,376	897,083	989,459
1941.....	368,712	255,912	116,208	740,832	97,065	643,767	740,832
1942.....	226,800	94,988	29,766	351,554	92,466	259,088	351,554
1942.....	226,800	99,688	29,766	356,254	92,666	263,588	356,254
1943.....	329,300	26,850	14,912	371,062	9,921	361,141	371,062
1944.....	851,743	103,950	62,535	1,018,228	15,587	1,002,641	1,018,228

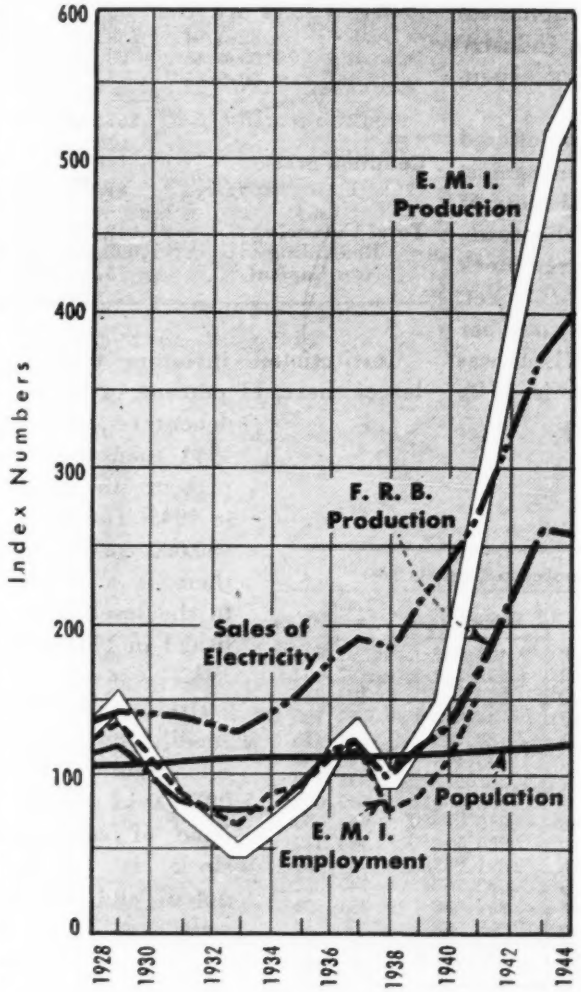


Manufacturers' Sales (Index: 1925 = 100)

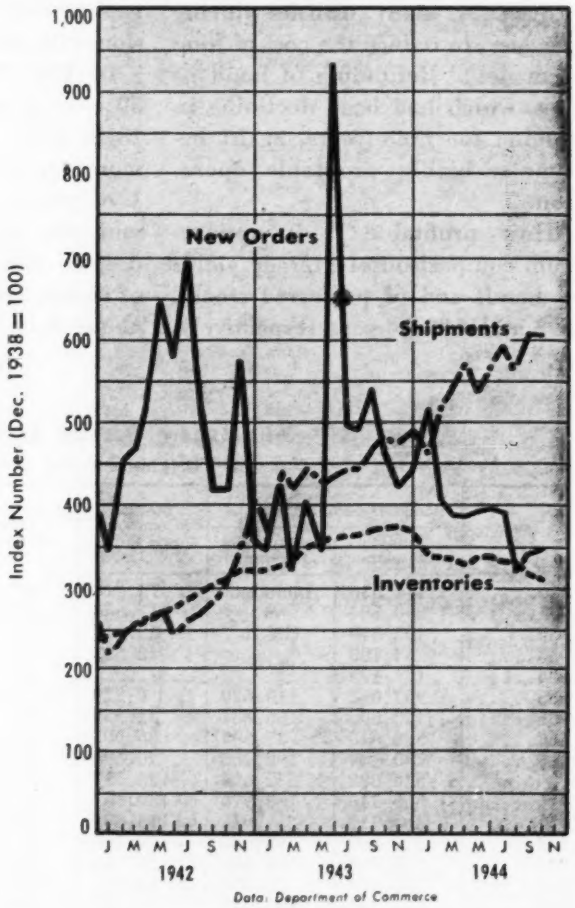
Still Busy on War Production

MANUFACTURING

Electrical Manufacturing and Related Factors



Electrical Machinery



Data: Department of Commerce

The Industry and Related Factors

Index Numbers 1925=100

	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944*
1. E. M. I. production	70	85	119	137	97	123	154	276	415	522	553
2. E. M. I. employment	88	94	106	128	77	84	106	155	†	†	†
3. F. R. B. production	82	96	113	124	97	120	137	178	219	263	261
4. Sales of electricity	141	155	180	199	187	212	238	281	319	372	400
5. Population	110	111	112	113	113	114	115	116	117	119	120
6. Electrical goods orders	63	77	109	133	90	124	205	336	555	†	†

Source: N.E.M.A. * Estimated. † Not available.

1. E.M.I. PRODUCTION based on U. S. Census of Manufacturers and data compiled by N.E.M.A. statistical department. In addition to products shown in electrical machinery apparatus and supplies schedule of the Census there are included electric refrigeration, radio apparatus and supplies, steam turbines for electrical drive, electrical porcelain, glass insulators and electric washing machines. Indices for the war years reflect production of non-electrical as well as electrical goods.

2. E.M.I. EMPLOYMENT based on labor series of National Industrial Conference Board, but adjusted to 1925=100. This series represents the electrical manufacturing industry including radio.

3. F.R.B. PRODUCTION based on the Federal Reserve Board's revised index for the manufacturing industry and adjusted to 1925=100. (Includes all revisions made by Federal Reserve Board up to Dec. 15, 1943.)

4. ELECTRIC POWER SALES index figures based upon Edison Electric Institute data.

5. POPULATION based upon the annual mid-year estimates of the U. S. Bureau of the Census.

6. NEW ORDERS booked — electrical goods — based on the quarterly reports of the U. S. Bureau of the Census.

Shipments made by manufacturers of electrical machinery according to the Department of Commerce reached a peak of 610, the highest in the record of the D of C index, in September, 1944. But new orders did not keep pace with shipments, averaging around an index of 400 in 1944 after a peak of 943 in the middle of 1943. Inventories in 1944 dropped about 30 index points from the general level of 1943. From these figures it appears that the industry is catching up with its knitting.

Apparently the electrical manufacturing industry operated in 1944 at practically the same production level as in 1943. The index figures of E.M.I. production for the two years in the table at the top of this page show about a 6 percent increase for 1944 over 1943. Summing up and comparing productions as indicated by the indexes in the table at the bottom of the page results in a figure of about 5 percent decrease in output of the products included in the listing. Since the lower table covers only electrical goods and the upper one all production in which is included a major output of war material not necessarily electrical in nature, one concludes that the industry kept plugging away at its war job without any let-up in 1944.

In going above the previous year's production level, a rise from 522 to 553, the industry went counter to the trend of all industry as indicated by the Federal Reserve Board production index with its figures of 263 and 261.

In this space in last year's statistical number it was remarked that apparently the absolute bottom in appliance sales had been reached in 1943. Perhaps the rise to the 1944 index of 17 from 12 in 1943 proves the truth of that remark. One can hope so. Sales of industrial apparatus, after large increase in 1943, fell off very slightly in 1944, but not enough to justify any conclusion of slowing-up in improvement and expansion of the nation's industrial plant. Continuation of the decline in sales of transmission and distribution equipment from the peak of 1943 shows in the index for 1944. There is continued decline also in sales of insulated wire and cable. The seeming contradiction between the index of industrial apparatus sales and those for transmission and distribution equipment and for insulated wire and cable may have explanation in the fact that much industrial apparatus is included in direct war production.

Major Branches of Electrical Manufacturing Industry

Index Numbers 1925=100

	Manufacturers' Sales	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944*
1. Appliances	100 = $140,000,000	73	92	121	136	109	128	151	212	73	12	17
2. Refrigeration	100 = 16,000,000	747	844	1,131	1,360	769	1,100	1,331	1,800	264	158	39
3. Electrical material	100 = 38,000,000	74	93	116	131	83	116	149	253	318	447	503
4. Industrial apparatus	100 = 132,000,000	59	83	118	161	97	127	177	317	465	638	631
5. Trans. and dist. equip.	100 = 167,000,000	33	50	83	124	90	104	124	189	213	167	125
6. Ins. wire and cable	100 = 110,000,000	36	46	69	98	60	71	87	157	155	135	125

Source: N.E.M.A. * Estimated.

1. APPLIANCES include domestic kitchen and table appliances, electric ranges, electric water heaters, electric vacuum cleaners, electric washing machines, electric fans and food service equipment.

2. HOUSEHOLD REFRIGERATION includes complete units, parts and cabinets. Commercial refrigeration equipment and air conditioning equipment are excluded.

3. ELECTRICAL MATERIAL includes carbon, electrical porcelain, laminated phenolic products, manufactured electrical mica and vulcanized fiber. Molded insulation is excluded.

4. INDUSTRIAL APPARATUS includes electric welding equipment and wire, industrial controls, industrial heating equipment and motors and generators (excluding all generators except motor-generator sets). Electric furnaces and electric tools are excluded.

5. TRANSMISSION AND DISTRIBUTION EQUIPMENT includes switchgear, high-voltage insulators, power and distribution transformers, lightning arresters, pole line hardware and earth anchors, panelboards and distribution boards, small air circuit breakers and watt-hour and demand meters.

6. INSULATED WIRE AND CABLE for light and power includes only the following types: weatherproof wire, paper-insulated power cable, varnished cambric cable, rubber-sheathed cord and cable and rubber-covered building wire.

All indices based upon U. S. Census of Manufacturers data and N.E.M.A. statistical department data corrected where possible to represent the entire industry.

More Expansion in 1944 REA

In 1944 REA cooperatives sold 1.560 kw.-hr. to the average customer at 3.32 cents per kw.-hr. for an annual bill of $51.70, according to figures for the year's operations presented here. The average number of customers per mile of line was 2.9. Allotted funds in distribution lines amounted to $1.120 per mile; adding generation and transmission to distribution brings the figure up to $1,243 per mile. These figures are of funds allotted for system construction and evidently include provision for some facilities not yet built. To arrive at per mile costs for lines actually in operation the figures should be scaled down by some factor. Say that factor is the ratio of funds advanced to total funds allotted, 78.4 percent. On this basis the costs per mile of distribution and of distribution plus transmission and generation work out to $878 and $975 respectively.

In furnishing the tabulated statistics for publication REA points out the large difference between costs of power for 1942 and 1943 and 1944, as explained in a note below the table and which results from a revision in the form of borrowers' statements.

Another REA notation refers to "Systems Generating Power" and "Generating Plants—Kw. Capacity" in the table:

"The actual figures for 1943 show 65 systems generating power with a capacity of 73,200 kw., whereas our estimate for 1944 shows 65 with a kw. capacity of 76,500. In connection with this it should be pointed out that the 65 systems generating power in 1943 are not necessarily the same 65 generating as of December 1944. Some systems have sold their generating facilities where power could be purchased at a lower cost and others which already were generating have acquired additional units which increased the kw. capacity of their installation. Also it cannot be assumed that each system generating power has just one permanent plant. It is possible for a system to have a diesel plant, a hydro plant and a mobile unit. It is therefore rather difficult to compare by years the number and total capacity of systems generating power."

Another REA comment says:

"It will be noted that the estimate for "Interest Accumulated Not Due" and "Current Interest Due and Payable" is considerably lower than last year due to a reduction in interest for REA borrowers as of September 21, 1944, from an average rate of approximately 2.7 percent to 2 percent. This reduction is the result of the provisions in the Pace Bill which was recently passed by Congress."

Statistics of REA-Financed Systems

(Prepared on the Basis of Reports Submitted by REA Borrowers)

Item	Calendar Year 1942	Calendar Year 1943	Calendar Year 1944*
Cumulative Year-End Data			
Total Funds Allotted	$460,467,729	$473,741,747	$518,500,000
Distribution Lines	$406,342,296	$419,820,140	$457,200,000
Generation and Transmission	$43,365,850	$42,995,144	$49,550,000
Consumer Facilities	$10,759,583	$10,926,463	$11,750,000
Funds Advanced	$364,324,196	$378,496,489	$405,770,000
Systems in Operation	803	811	825
Miles of Line in Operation	378,015	390,058	408,500
Consumers Connected	1,012,284	1,087,801	1,216,000
Systems Generating Power	60	65	65
Generating Plants—KW. Capacity	57,500	73,200	76,500
Annual Data			
Energy Generated—KW. Hr.	131,189,138	199,228,028	205,000,000
Energy Purchased—KW. Hr.	1,304,622,796	1,828,132,383	2,075,000,000
Total System Input	1,435,811,934	2,027,360,411	2,280,000,000
Energy Sold—KW. Hr.	1,150,535,928	1,679,381,428	1,895,000,000
Operating Revenues	$46,927,322	$55,587,614	$62,920,000
Cost of Power	$11,787,629†	$16,728,209	$19,050,000
Salaries and Wages	$7,062,530	$7,291,457	$8,320,000
General Expenses	$5,684,122	$5,114,339	$5,740,000
Insurance, Taxes and Misc.	$2,336,438	$2,647,332	$2,870,000
Total Operating Expenses	$26,870,719	$31,781,337	$35,980,000
Net Non-Operating Income	316,665	$417,760	$470,000
Interest Due and Payable	$6,580,520	$8,128,335	$8,200,000
Interest Accumulated Not Due	$2,203,742	$1,104,476	$610,000
Net Income Before Depreciation	$11,473,419	$14,654,317	$18,600,000
Payments to Government Cumulative Data			
Interest Due	$19,642,302	$29,836,009	$40,867,000
Interest Paid	$19,490,956	$29,638,004	$40,576,000
Principal Due	$9,448,658	$16,150,385	$27,375,000
Principal Paid	$18,593,565	$31,302,737	$45,445,000
Overdue Amounts—More than 30 days	$213,291	$215,576	$356,000
a. Interest	$89,219	$157,470	$200,000
b. Principal	$124,072	$58,106	$156,000
Advance Payments of Principal	$9,325,029	$15,229,508	$18,238,000

Source of Data: Statistical Reports Published by REA.
1. Special summary of monthly operating reports of REA borrowers.
2. Allotment, construction, operating and financial statistics of REA-financed systems for December 31, 1943 and 1944. These are not complete consolidated statements, inasmuch as all borrowers do not report on all items.
3. REA Monthly Statistical Bulletins.

*Nine months actual in most cases and two to four months estimated. The varied nature of small rural systems in a National program and the impact of wartime uncertainties have made it difficult to estimate data with a high degree of accuracy. Figures reflect all information available from borrowers, but not every borrower reports on all items. Data on operating expenses of borrowers' systems are not summarized regularly by the Rural Electrification Administration.

†Cost of Power for 1942 includes cost of purchased power only, with prime costs of generation prorated to Salaries and Wages and General Expense. Figure for 1943 and 1944 includes both cost of purchased power and prime costs of generation.

Chronology of

1944

JANUARY

U. S. Supreme Court sustains FPC decision in Hope Natural Gas Co. rate case, allowing 6½ percent return on $33,000,000 rate base arrived at on Prudent Investment basis. Majority decision refuses to hold either for or against any theory of valuation.

Hood River People's Utility District in Oregon defeats proposed $175,000,000 bond issue to acquire electrical utilities outside district. Purchase of Pacific Power & Light Co., Northwestern Electric Co. and Portland General Electric Co. facilities involved.

George Otis Smith, chairman of FPC in President Hoover's administration and for many years director of the U. S. Geological Survey, dies.

OWU issues new Order U-I; simplifies controls on utilities and reduces amount of paper work necessary for compliance.

WPB calls halt on power generating expansion. Restrictions to continue until "probable future course of the war becomes clearer."

State of Vermont joins residents of West River Valley, near Brattleboro, in fight against federal plans to build a flood control and power dam at West Dummerston.

SFAW revokes order permitting use of fuel oil for power generation in Atlantic Seaboard plants having coal standby facilities.

Senate rejects amendment to Tax Bill, allowing federal contracts for electric service to be exempt from statutory renegotiation of profits.

A.I.E.E. holds annual technical convention in New York.

First phase of Senate investigation of REA ended.

U. S. Supreme Court upholds FPC's right to remove write-ups from utility plant accounts. Northwestern Electric Co. involved.

A.S.C.E. permits local sections to act as collective bargaining agency for engineers; A.I.E.E. appoints committee to study collective bargaining.

FEBRUARY

Attempt to halt REA investigation charged; proceedings go on without funds, Senate having refused to act upon resolution appropriating $12,500 for probe.

Thomas A. Edison's 97th birthday celebrated.

Possibility of OPA taking jurisdiction over electric utility rates revealed in Davies Warehouse case decided by U. S. Supreme Court. Court fails to take stand on OPA's jurisdiction in unregulated areas.

Detroit Edison Co, files suit in Circuit Court to determine validity of city's 20 percent excise tax on utility gross revenues.

IBEW calls strike against Los Angeles Department of Water and Power; production halted in war plants. Army takes over for week. Strike ends as early settlement of wage dispute looms.

Move to acquire Puget Sound Power & Light Co.'s distribution facilities in 19 western Washington counties by a combine of 16 public utility districts for $33,000,000 announced. Also plan of City of Seattle to purchase transmission facilities within city.

A.I.E.E. awards Lamme Medal to Arthur H. Kehoe, Consolidated Edison vice-president.

New tax bill enacted over President's veto. Rise in excess profits tax to effect utilities.

MARCH

New Jersey Board of Public Utility Commissioners announces new simplified method of adjusting rates without long formal hearings in New Jersey Power & Light Co. case. Rate of return geared to cost of money plus allowance for equity capital.

Underwriters Laboratories, Inc., celebrates 50th anniversary.

N.E.M.A. establishes Information Center; Moorhead to direct.

Senator McKellar attacks TVA before Congress; amends Independent Offices appropriations bill to require agency to pay all receipts into the Treasury and to go to Congress for its appropriations. FPC budget reduced; SEC fund unchanged.

Electric light and power industry gets Coffin Award.

U. S. Supreme Court rebuffs OPA in rate case. Upholds Court of Appeals ruling, sustaining District of Columbia Public Utilities Commission ruling granting Washington Gas Light Co., increase. Doubts Stabilization Act of 1942 confers "right" to intervene to economic stabilizer or agent.

Bonneville Power Administrator Raver, acting as agent for 16 public utility districts in Washington, the City of Seattle and the federal government, offers $90,000,000 for Puget Sound Power & Light Co.

APRIL

OWU amends supplementary order U-I-C,D,F and H to curtail use of distribution transformers.

Utilities Wartime Aid Conference held in New York.

Quebec legislature passes bill, expropriating properties of Montreal Light, Heat & Power Consolidated.

Falck named OWU director to succeed Krug, who enters Navy.

Pacific Gas & Electric Co. puts Pit River No. 5 plant in operation.

MAY

Treasury announces plan to discontinue tax exemption on electric energy sold to federal government after June 1.

OWU eases restrictions imposed by amendment to order U-I-C.

War Contracts Price Adjustment Board prescribes procedure for electric utilities filing mandatory financial statements on war business. Army designated as reviewing agency.

PUDs drop condemnation proceedings to acquire Puget Sound Power & Light Co.'s system.

Argentina seizes U. S.-owned utilities.

Michigan Supreme Court decision directs state Public Service Commission to consider excess profits in fixing rates of Detroit Edison Co.

Cities Service notifies SEC of plan to drop utility properties. Will retain oil, wholesale natural gas, real estate and other non-utility business.

Texas Power & Light Co. makes contract to purchase Denison Dam power.

U. S. Supreme Court rules against OPA. Reverses injunction granted by a New Jersey district court halting a one-cent increase in fares charged by Hudson & Manhattan Railroad Co.

WPB orders shutdown of aluminum potlines at Maspeth, Long Island.

JUNE

E.E.I. holds annual meeting in New York.

U. S. Supreme Court agrees to review District of Columbia appeals court decision, upholding the constitutionality of the "death sentence" clause of the Holding Company Act. Engineers Public Service Co. sought high court review.

REA investigation closed by Senate.

FPC terminates Southwest Power Pool rate case, following a finding that rates are not unjust, unreasonable or unduly discriminatory.

Detroit Edison Co. asks state Supreme Court for rehearing in rate case. At meeting called by Public Service Commission, Michigan utilities oppose plan to cut rates to avoid payment of excess profits taxes.

Authority over war power contracts given to Army Service Commands.

I.E.S. elects new officers. S. B. Williams, editor, ELECTRICAL WORLD, new president.

Sacramento starts condemnation proceedings against Pacific Gas & Electric Co.

President Roosevelt signs bill, providing for construction of Hungry Horse Dam on Flathead River, Montana. Ultimate capacity of power house 150,000 kw.

Independent Offices Bill passed by Congress; McKellar amendments on TVA dropped. Loan funds for REA set at $25,000,000 in Agriculture Appropriation Bill.

Secretary Morgenthau announces Treasury Department will not oppose utility rate reductions to protect its revenue.

Public Service Electric & Gas Co. ordered by New Jersey Board of Public Utility Commissioners to reduce electric rates $5,000,000 annually.

Congress recesses after passing Agriculture, Interior and Independent Offices appropriations bills. Flood Control and Rivers and Harbors bills held over.

A.I.E.E. holds annual summer technical meeting in St. Louis. C. A. Powel elected president.

Senate Agriculture sub-committee investigating REA submits interim report. Urges passing of bill restoring REA as an independent agency. States dissension among higher-ups apparent. Slattery removal criticized. Carmody praised as "excellent administrator".

Nelson announces limited reconversion program.

Arkansas Utilities Commission establishes $47,996,290 rate base for Arkansas Power & Light Co. Finding follows months of hearings and terminates dispute among Arkansas board, FPC and power company over rate base yardstick. Ruling establishes Prudent Investment standard for rate base and 6 percent as reasonable rate of return.

Detroit Edison Co. denied rehearing by the Michigan Supreme Court of its decision on war taxes in determining rates.

California Railroad Commission investigates charging of war taxes to operating expenses. Sends "show cause" orders to 130 utilities.

JULY

Denison Dam dedicated.

Shasta generators placed in operation.

District of Columbia Public Utility Commission orders Potomac Electric Power Co. to cut rates $1,037,189; reduction eliminates all federal excess profits taxes; annual rate of return reduced from 6 to 5.5 percent.

OPA intervention barred by District of Columbia Public Utilities Commission in Capital Transit Co. rate case.

AUGUST

Detroit Edison Co. ordered by Michigan Public Service Commission to refund $10,450,000 to its customers.

Power projects planned for Colorado River area. Arizona and Reclamation Department officials confer on $640,000,000 undertaking. Generating stations proposed for Marble Gorge, Bridge Canyon and Lake Havasu.

Arkansas utilities seek to have Ark-La co-op placed under regulation of Department of Public Utilities.

Appliance production gets restricted WPB approval. Manufacturers, with exception of refrigerators and washing machines, authorized if manpower and facilities are available.

Senator Murray of Montana introduces bill in Congress, proposing the creation of a Missouri Valley Authority.

Arkansas Power & Light Co. appeals rate cut decision.

Krug made Acting WPB Director, replacing Charles E. Wilson, who returns to General Electric Co. Nelson to leave on mission to China. Falck remains OWU Director.

OWU permits expansion of generating, transmission and distribution facilities in new order.

District of Columbia Public Utilities Commission refuses to reconsider order cutting Potomac Electric Power Co.'s rates $1,037,000. Utility carries case to Court of Appeals.

U-I restrictions relaxed by OWU in supplementary orders.

Federal officials join City of San Francisco in seeking further stay of injunction halting city's sales of electric energy from Hetch-Hetchy project to Pacific Gas & Electric Co. Compromise submitted by city rejected by Acting Interior Secretary Abe Fortas as violation of Raker Act.

Diversion of high-grade coal to coke plants and by-product users affects utilities.

SEPTEMBER

Congressional group confers on War Surplus Property Bill. Committee filled with pro-public ownership legislators.

Detroit Edison Co. carries rate case to court.

San Francisco granted six-months' stay by Federal Court to work out Hetch-Hetchy problem with Pacific Gas & Electric Co.

George W. Norris, father of TVA and veteran of 40 years in Congress, dies.

Strikes in soft coal area menace supply.

New renegotiation forms sent utilities by War Department's power procurement officer.

Arkansas Power & Light Co. denied rehearing in rate case by state commission.

WPB orders further cut in aluminum production at four government and four privately owned plants.

Leland Olds confirmed by Senate for FPC post.

Charles E. Wilson returns to presidency of General Electric Co. Swope and Young resign. No new chairman named.

First of five generators planned for TVA's Kentucky Dam goes into operation.

Hurricane hits eastern seaboard.

Revised Surplus War Property Bill approved. Compromise resulted from widely conflicting House and Senate bills. REA co-ops lose equality with state and federal agencies in buying surpluses. Senate favoritism for public power toned down.

Basil Manly elected chairman of FPC. Leland Olds now vice-chairman.

Ark-La cooperative denies being a public utility in brief filed with State Department of Public Utilities.

FPC halts rate increase by Connecticut Power Co. for energy sold to Torrington Electric Light Co. Connecticut Public Utilities Commission had approved increase.

SEC refuses Ohio villages a rehearing on sale by Associated Electric Co. of Ohio-Midland Light & Power Co. to three rural electric cooperatives in Ohio.

Nelson resigns; Krug made head of WPB.

OCTOBER

First national electronics forum held in Chicago.

Circuit Court of Appeals dissolves injunction restricting union (IBEW) boycott. Eleven major electrical manufacturers involved.

Soviet Russia to get nine hydro-electric turbo-generators. General Electric to build units for installation at Dnieprostroi Dam.

OWU announces ban on Christmas lighting will be continued this year.

Co-ops oppose Arkansas Power & Light Co. on rural line extensions at hearings before state Department of Public Utilities. REA officials participate in fight.

Labor joins business-managed and municipal utilities in Washington in fight on P.U.D. measure, known as Referendum 25. To be voted on at November election.

FPC vacates order suspending rate increase by Connecticut Power Co.

Agriculture Department announces five-year post-war rural electrification plan to cost $1,042,000,000.

At annual meeting in New York, N.E.M.A. launches drive to hasten "Electrical Age." "Declaration of Electrical Interdependence" drawn up. A. C. Streamer, Westinghouse, elected president.

NOVEMBER

President Roosevelt re-elected.

Referendum 25 defeated 7 to 5 in Washington.

OWU authorizes installation of 23 generating units; fifteen in municipal plants.

In Panhandle Eastern Pipeline case, U. S. Supreme Court approves Prudent Investment theory of rate setting as employed by FPC.

Tie-line arrangement installed between Commonwealth & Southern systems and TVA. Three hydro plants selected as control points.

Army Engineers and Bureau of Reclamation reach agreement on plan for development of the Missouri River Valley. MVA seen less likely.

Delegates at War Conference of National Association of Railroad and Utilities Commissioners refuse to accept principle of "Straight-Line Depreciation" for utilities. George C. McConnaughey elected president.

Union Electric Co. announces $100,000,000 construction budget.

War production lag curbs reconversion. OWU holds up the post V-E Day version of Order U-I.

Ark-La Electric Cooperative ruled a public utility, subject to regulation by Arkansas Department of Public Utilities.

Detroit Edison Co. plans $125,000,000 program for first ten post-war years

Power Exposition held in New York.

James H. McGraw Medal for Cooperation awarded posthumously to Carl M. Snyder, founder of General Electric Co.'s Home Bureau.

Canada forms own N.E.M.A. under name of Canadian Electrical Manufacturers Association. Headquarters set up in Toronto with Roy D. Kerby as general manager.

DECEMBER

E.E.I. reorganizes commercial division.

I.E.S. ends agreement on lamp certification.

Harry Slattery resigns as REA Administrator.

A.I.E.E. Edison Medal awarded to E. F. W. Alexanderson of General Electric Co.

European war demands put end to reconversion. Occupationally deferred men, who leave war jobs without consent of draft boards, will be drafted and induction of men over 26 will be renewed.

Sacramento awarded a Superior Court judgment in condemnation suit against Pacific Gas & Electric Co.

Court affirms Arkansas Department of Public Utilities order, fixing rate base of Arkansas Power & Light Co. at $48,000,000 and cutting rates $975,000 annually.

Bill establishing a Rural Telephone Administration, similar to REA, introduced in Senate with $100,000,000 lending power.

Non-profit corporation buys Nebraska Power Co., last private power utility in state for $14,421,000.

Dr. Charles F. Scott dies.

Rivers and Harbors Bill dies with 78th Congress.

Bill allowing TVA co-ops to become REA co-ops passed by both houses.

Los Angeles Department of Water and Power announces $124,344,500 post-war program.

V. M. Marquis named director of OWU's power division to succeed Barclay J. Sickler, resigned.

James B. Black, president of the Pacific Gas & Electric Co., refuses to transmit Hetch Hetchy power to Mare Island and Hunter's Point Navy yards as Secretary Ickes had proposed.

E. Robert de Luccia named chief of the Federal Power Commission's Bureau of Power under which the former Bureaus of water power and electrical engineering will be consolidated in a move to bring all FPC electric power engineering activities under unified direction.

Provinces of Ontario and Quebec start negotiations on development of Ottawa River as a source for hydro-electric power. Six sites are selected.

The Year in Review

Looking back over the past year shows electric utility performance as a faithful mirror of national conditions, reflecting mood and tempo of government and people in relation to the war

FRANK R. INNES
Assistant Editor, "Electrical World"

IN 1943 THE STORY OF THE ELECTRIC UTILITIES was of an industry all out for war. In 1944 the industry was not all out; it could have been and it was prepared to be, but the utmost was not required of it. The outstanding fact to be seen in looking back over the record of the utilities in 1944 is the behavior of the curve of weekly energy output. It started out even higher above the curve of 1943 than 1943 was above 1942. But, slowly at first and then faster as the year wore on, the distance separating the 1944 and 1943 curves lessened, until early fall when 1944 crossed and dropped below 1943, and remained below up to late December. In the curve of 1944 electricity output is epitomized the whole story of the nation's overconfidence that was so rudely shattered in the closing weeks of the year.

Production Operations

Even though the changes in significant quantities of utility performance were not as great in 1944 as events have shown they should have been, yet, standing by themselves, these changes are not small by any means. The 1944 increase in output was over 13 billion kw.-hr., a figure greater than the increase from 1939 to 1940, a time when American industry was going strong on war production for the nations with whom we are now allied. The increase in installed capacity in 1944 is also a quantity not to be sneezed at; 1.2 million kw. is a lot of capacity at any time; it seems small only as it is compared with the phenomenal increase of 3 million in 1943. The same observation applies to the estimated increase in aggregate peak load in 1944 of one million kw., small in comparison with the 1943 rise of over 4 million but large by any other yardstick. So also does it apply to the increases in energy sold, 11.7 billion kw.-hr. and in revenue, $162 million, both respectable figures in absolute terms.

Capacity added during the year, combined with the slacking-off of energy usage, resulted in an only slight increase in kw.-hr. output per kw. of average capacity; 4,617 in 1943 and 4,626 in 1944. This change of only 9 kw.-hr. is so small that it may easily be an error in estimating, to be wiped out when complete figures for the year are compiled. However, this ratio of output to capacity shows a significant condition when resolved into its fuel and water power components. Output per unit of hydro capacity dropped from 5,458 to 5,178 kw.-hr. while fuel power production rose 4,285 to 4,396.

Revenues and Expenses

From sales of energy in 1944 the utilities took in 3¼ million, 5.6 percent more than in 1944. Of this about ⅓ was from residential service for which average figures are now $39.90 annual bill for 1,140 kw.-hr. at 3½ cents per kw.-hr. These are rather remarkable figures for residential customers considering that load building activities were turned off like water from a faucet over two years ago. One concludes that people are staying home more, that efforts to keep domestic electric equipment in working order are having success and the few electrical appliances allowed to be produced in 1944 were immediately put to work.

The significant ratio of operating expenses over operating revenue continued to edge upward during the year. It now stands at 41.7 percent before taxes; after taxes the ratio is 65.6 percent. In the ten years since 1936 the ratio has climbed about five percent before, and about 15 percent after, taxes. About three-fifths of the increase in the ratio before taxes has occurred during the war period, but most of the rise after taxes took place before the war.

An important cause in the rise of operating expenses is the fuel bill which has doubled in the four years from 1940 ($200 million) to 1944 ($400 million). In the same period the output of energy from fuel power increased only some 60 percent and also the weight of coal burned per kw.-hr. was reduced slightly. Thus it is that fuel is taking a larger slice out of operating revenue.

Another instance of the slacking-off in the tension of war in 1944 is to be seen in the increase in number of utility customers, now over 33 million, an increase of nearly 700,000 over 1943. About 70 percent of the increase is in the residential customer class. Noteworthy is the fact that the commercial and industrial

customers group increased in number in 1944 after declining in the two previous years. However, this class of customers is still substantially smaller than in the year before we entered the war.

Kilowatts and Dollars

In the year past the industry added over 1.5 million kw. of new capacity which resulted, after subtraction of generation taken out of service, in a net increase of 1.2 million, making the present installed capacity 50.5 million kw. Of this 35.8 million is in fuel power plants and 19.7 in water power. Plans are in hand for installation of 1.3 million kw. in 1945 and of 2 million in 1946 and later.

This statistical number of ELECTRICAL WORLD reports again on construction of transmission lines. This feature was missing from the two previous numbers. But the statistical series presented this year is made complete by the cooperation of the reporting utilities who dug back into their records for miles of line built in 1942 and 1943. The sequence of figures, —2,618 miles in 1939, 3,779 in '40, 6,222 in '41, 5,889 in '42, 3,293 in '43, 2,214 in '44 and 4,499 planned for '45—shows clearly how the utilities saw their war job ahead, prepared for it, continued with essential construction in the war years and then, in the mistaken general confidence of 1944, set up an enlarged program of line building.

Construction that was projected for 1945 would have required the largest capital expenditure made by the utilities in 15 years. It is impossible even to guess how much of the construction program contemplated for 1945 will actually be carried out.

In 1944 money put into capital construction by the utilities amounted to $340 million. Less than 5 percent of that amount was new money coming into the industry. Yet 1944 with its total of over a billion dollars was the year of largest utility financing operations since 1936 when, as was reported last year, practically all financing was refunding of debt.

Sales and Sales Plans

Sales of energy in 1944 missed reaching the 200 billion kw.-hr. mark by about one percent. It was only 5 years earlier, in 1939, that sales had gone over 100 billion. Evidence of how war speeded up the national industrial machine is the fact that over two-thirds of the increase in those 5 years was in sales to large light and power customers.

After being stopped from load building early in 1942, the utilities began last year to do some ambitious thinking about what they would do in that direction as soon as they could. Surveys of customer's wants made by many utilities and other interested agencies totalled up to impressive figures of potential sales of all kinds of electrical appliances and equipments. The success of "swap" arrangements by which people who wanted appliances were brought together with others who would sell their toasters or flatirons or what have you, plus the effectiveness of organized efforts to keep appliances in repair, these and other causes combining to keep residential use of electricity climbing at a remarkable rate substantiated the findings of the surveys and studies. But there were some counter evidences, too. One of these was a survey made early in the year by the Office of Civilian Requirements which showed that American families wanted a number of other things more than they did electrical appliances. Another was a study made by ELECTRICAL WORLD, published in November, which indicated that perhaps the utilities were setting their sights too low in their thinking on post-war loading building.

Community Development

"Better Light—Better Sight" rounded out its first ten years in 1944, thus furnishing occasion for speculation on accomplishments of the next decade. And from the promises shown in the past few months those accomplishments will be great. The new "Slim Line" and circular fluorescent lamps open up possibilities for integrating illumination into building design such that estimates of a lighting market approaching a billion dollars in the first five post-war years do not seem at all unreasonable.

Electric heating of homes and business places came again to the forefront of consideration. Methods discussed and in experimental development ranged from straight resistance heating and radiant panels through various ways of accumulation and storage to the intriguing idea of the heat pump. A comprehensive paper on the last-named was presented at the annual meeting of the Edison Electric Institute in June and created considerable stir.

Evidence that the utilities see opportunity to perform even larger services for their customers is found in the plans of many for industrial and other community development. Particularly in the Southeast such plans are large in the thinking of utility men. This kind of work is not new to the utilities: they have been active and effective in it for many years. But they have not sought nor have they been given much credit for it, as was made apparent in the debate on the Bailey amendment to the Flood Control Bill in the Senate in early December when senator after senator expressed doubt that the power companies had contributed anything to the development of their states.

Engineering

Great interest in the gas turbine and much speculation as to its ultimate applications and values were created last year by disclosures of the important roles forms of this engine are playing, particularly in aviation development under the pressure of war. Solutions to many of the metallurgical and specific design problems of the gas turbine have already been found or are in sight.

A major problem that will confront the utilities when

the war is over is that of cost of distribution systems. Substantial increases in load-handling capacity and expansions to reach new customers, rural especially, will be necessary. Much engineering study was given in 1944 to this problem and there appears to be a resulting disposition to raise the level of distribution primary voltages.

Rates and Regulation

In 1944 this magazine printed some 65 items stating rate reductions that totalled around $17 million. Mentioned frequently in connection with these reductions was avoidance of payment of excess profits taxes by the utilities. The position of companies under this kind of attack was not helped at all by a statement from the Secretary of the Treasury that the Federal government was quite happy to forego collection of the tax in the interest of rate reductions.

Inference that the "original cost" theory, so ardently espoused by the Federal Power Commission, was definitely socialistic in nature was contained in an order by the Arkansas commission to the Arkansas Power & Light Co. And the accounting profession was "shocked" by FPC's attempt to apply that theory of rate making in the A.P. & L. case, said the chairman of the committee on public utility accounting of the American Institute of Accountants.

The Supreme Court refused to put any limitation on regulatory bodies as to manners of rate determination. It held that it is not the theory but the impact of a rate order that counts. And delegates to the 1944 war conference of the National Association of Railroad and Utilities Commissioners refused to adopt a resolution recommending straight line depreciation accounting for utilities.

Public Power

Although municipal ownership of electric utilities had fewest election wins in 1944 in many years, yet it did, or will soon, take one big prize. This was the sale of the common stock of the Nebraska Power Co. to a non-profit organization of three citizens of the state. Purpose of these citizens is to sell the utility to the city of Omaha. The total sale price will be some $40 million.

Before it passed into history the 78th Congress passed the Flood Control Bill which contains provisions but no appropriations for several power dams. Before the bill was passed amendments authorizing the St. Lawrence project and a Missouri Valley Authority were dropped from it. Effort was made to get St. Lawrence approval as an amendment to the Rivers and Harbors Bill, but it was shorn from there also. Anyway the bill died with the session. On a vote by itself in the Senate the St. Lawrence proposal was beaten 56 to 25. In the present Congress the MVA proposal has certain hurdles to get over. One is an agreement between the Army representing "navigationist" sentiment, and the Department of the Interior, representing "irrigationist" ideas, on their respective shares in the development of the river. Another is congressional reluctance to establish additional Federal Agencies for purposes that can be adequately handled by existing departments of government. This attitude of the Congress is bolstered up by recommendations from the National Rivers and Harbors Congress and the Western Regional Council of State Governments.

In the Northwest, anti-power company forces received two major setbacks. One was the defeat early in the year of a $175 million bond issue by which the Hood River (Oregon) Peoples Utility District planned to take over Pacific Power & Light, Northwestern Electric and Portland General Electric properties. The other was the refusal of electors to approve the so-called Referendum 25 in the state of Washington. This proposal would have allowed all of the power companies in the state to be taken by the PUD's.

REA Investigation

Defiance of a Senate committee by a presidential secretary, odorous and violent charges and counter charges, efforts to force its appointed administrator to resign and one of its top officials saying "To hell with the law", are a few excerpts from the 1944 political history of REA. At the end of the year the administrator, Harry Slattery, did resign, having waited long enough to show that he was not forced out.

As an operating organization REA presented a much better picture than it did politically. It revealed the details of a 5-year post-war plan to bring electric service to 3,655,000 rural dwellings at a cost of over $1 billion. The plan envisages a wiring market of $725 million and sales of farm and household appliances at over $3 billion.

There was considerable misgiving at the beginning of the year that the utilities would run into trouble on account of coal shortage. But this turned out to be another of those horrible things that never happened. At the end of November the utilities actually had more coal on hand than they did on the same date in 1943, 82 days supply as against 69.

Win the War First

Relaxation of controls on materials and manpower allowing some manufacture of electrical appliances and larger provisions of electric system facilities gave the utilities a small foretaste of post-war. But that did not last long as we all know and there is small value in reciting its disappointing tale. And the utilities are now back, as all should be, at their single and only job of winning the war.

As in 1943 electrical manufacturers plugged along turning out, not only electrical products, but a long line of specialized equipment for the Army and Navy. The manufacturers found time, however, to subscribe to a "Declaration of Electrical Interdependence" by which all elements of the industry are pledged to work together to speed the coming of the Electrical Age.

Electrical Manufacturers Geared to War Production

Output of war goods maintained at maximum through 1944 — Joint RMA-NEMA committee on electron tubes—Standardization of equipment and ratings

A. C. STREAMER
President, National Electrical Manufacturers Association

THE ELECTRICAL MANUFACTURING INDUSTRY was in high gear when 1944 started and has remained there all year. The rate of increase in production of goods largely to meet the requirements of the Armed Services, of necessity had to level off after the record acceleration of the three previous years: 1941 almost double 1940; 1942 fifty percent above 1941; and 1943 about one-third above 1942.

Due to the effective operation of WPB and the electrical manufacturing industry's cooperation with it, material procurement was not the outstanding problem as in earlier years.

Manpower was still the number one problem. Again, thanks to cooperation with Washington and the further utilization of female help, this situation was solved fairly well.

Present indications, largely predicated on reliable figures for the first ten months of 1944, are that the industry's 1944 production was about five percent above 1943. This compares with an apparent leveling off by all industry (Federal Reserve Board index of production).

So-called heavy industrial apparatus was leveling off well before the year's end. Electrical appliance sales reached almost microscopic figures.

A tremendous portion of the production of electrical manufacturers in 1944 went into the ships of our Navy and Merchant Marine. This includes electrical propulsion equipment, switchboard apparatus, auxiliary motors and control, radio and a host of smaller items, such as searchlights and bracket fans. Diesel-electric and turbine-electric drive for Navy destroyer escort vessels and Coast Guard cutters and ice breakers and turbine-electric drive for troopships and tankers built by the Maritime Commission constituted a large portion of the year's output.

One important cooperative activity was implemented in 1944.

By agreement between the Radio Manufacturers Association and NEMA, a plan was adopted and an organization established for the standardization of all classes of electron tubes. The basis of the plan is that such standardization, numbering, nomenclature, etc., shall be undertaken for the industry by an organization established for that specific purpose and that such organization will be sponsored jointly by RMA and NEMA.

This organization will be known as the "Joint Electron Tube Engineering Council of RMA and NEMA."

"JETEC" will consist of a council of four—two representatives from NEMA and two from RMA. Reporting to the Council will be such committees as are, in the judgment of the Council, necessary to perform the work.

The membership of these committees will not necessarily be restricted to representatives of RMA or NEMA member companies. JETEC will obtain the best engineering talent to work on its committees to do the best possible job for industry.

Both the Council and its committees will maintain close contact with the Joint Army-Navy Specifications groups.

We believe that the establishment of JETEC will provide a mechanism capable of doing an outstanding job for the industry.

Post-War Plans

In the early fall NEMA with most other industries, based on now known false optimism concerning VE day, started making plans for post VE promotional activities. Budgets were approved for expanded activities on Adequate Wiring, Rural Electrification, Street and Industrial Lighting, Industrial Electronics and various household electrical appliances. Hitler and Von Rundstedt changed all this last month.

Again the electrical industry's number one task is, to the best of its ability, to meet the requirements for its products by the Armed Services.

It still realizes that when that deferred happy time arrives it has an obligation to the public and its own

employees through prompt reconversion to help realize that full employment so necessary to maintain the nation's economy under Free Competitive Enterprise.

Unless, as it now still appears unlikely, war demands call for more expansion of heavy industry it is believed there will be a considerable reduction in the production of large electrical equipment.

It is believed that 1944's high rate of production of marine electrical equipment will drop off late in 1945 due to decreased merchant ship building activity.

Further decreases will be seen in electrical products for homes and industrial buildings.

On the laps of the gods of war is the answer as to when considerable production of electrical household devices will occur.

Despite war demands there has been measurable progress by engineers and technicians in the designs of electrical apparatus.

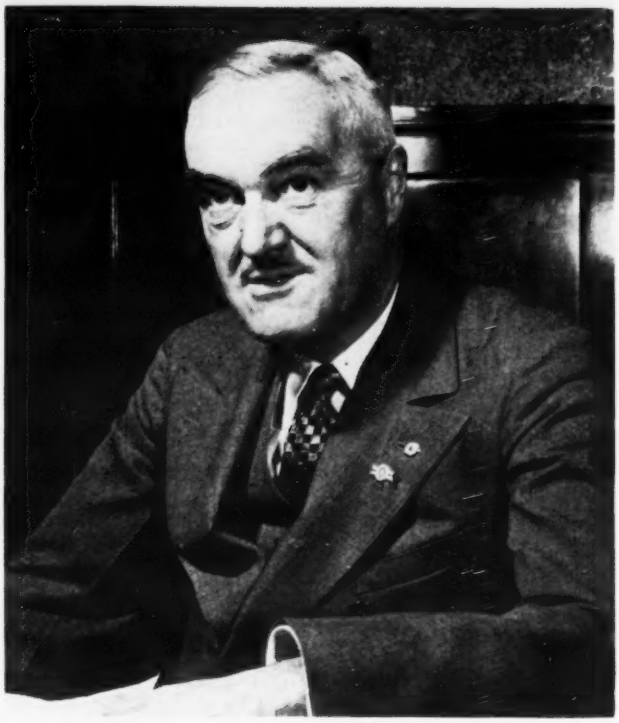
Steam railroads are definitely planning for higher operating speeds of both their freight and passenger trains. This of course calls for more powerful motive power. For the electrified zones, electrical locomotives are now being designed for 7,500 hp. and 10,000 hp. in one cab. For the non-electrified zones, a new steam turbine mechanical drive locomotive of 6,500 hp. is now undergoing test runs.

Progress in Standardization

The joint efforts at standardization on the part of the utility industry and the electrical manufacturing industry should bear fruit during the coming year. All-industry committees working through AIEE and ASME have just about completed their work on standardization of turbo-generator ratings. The triple joint Switchgear Committee representing AEIC, EEI and NEMA, have effectively continued their work on switchgear standardization. Similar work is also going on in connection with distribution transformers. Work is being started on power transformers. All of these moves toward standardization should bring to the industry more simplified and standardized apparatus than has even been the case before. Electrical manufacturers should thus be in a better position to serve purchasers of electrical apparatus.

It is our opinion that the so-called general mill industries—and these include paper, textile, rubber, and food—offer the best opportunities during the immediate post-war period. This is due in part to the fact that these industries have been more seriously affected by raw material and manpower shortages than any of the other industries.

The steel industry will also be a larger consumer of electric power in the post-war period due to the increased finishing operations in the manufacture of peacetime products. Steel will continue to be one of our largest peace-time customers as we will continue to look to the steel industry for a large volume of our business.



A. C. Streamer

Airports also represent a tremendous volume of business for the electrical industry which will in some measure compensate for the drastic reduction in the requirements of the aviation industry as a whole.

There is a great pent-up demand for fluorescent lighting in commercial establishments, the home and non-essential industrial buildings.

Tremendous import lies in the war-accelerated development of electronics particularly its best known war child and also in the X-ray field.

Designs are available for many new and improved products for the "home of tomorrow" when the age of "electrical living" arrives to give surcease to the war-time worries of the housewife. Less drudgery, less cleaning and greater comfort.

We all believe that this particular market will be the electrical industry's greatest answer to the problem intermediate between the stoppage of war production and reconversion to normal peace-time needs.

Maintenance

Before closing I want to make a special plea for attention by industry to one activity of predominant importance under current over-time, and in many cases over-capacity, production.

I refer to the problem of *maintenance*.

"For the want of a nail, the shoe was lost —," and for the want of a renewal part and proper maintenance too often production stops.

Good maintenance costs money and interferes with continuous production schedules. However, it pays tremendous dividends on the investment and saves many actual hours of production.

Editorials

S. B. WILLIAMS, *Editor*

The Budget That Might Have Been

ESTIMATES OF EXPENDITURES for future plant expansions always fall into the class of "if" subjects. This is understood by those who make the estimates and by those who read them. Until its 39th Annual Statistical Number, printed in January, 1943, ELECTRICAL WORLD's presentation of projected expenditures by electric utilities had always regarded the "if" factor as not very consequential. That number recognized that the "if" had changed into the certainty that expenditures in 1943 would be determined entirely by war requirements and estimates of them would be practically impossible. Thus the 39th A.S.N. contained no budget figures. For the 40th the "if" was back—if Germany were defeated in the first half of 1944. Germany was not defeated in that time, but we all went most way through the year confident that V-E Day would come in the second half. And business made ambitious plans for 1945.

Now, in this 41st Annual Statistical Number is presented another electric utility budget in which again there is no "if"; there was one but it turned into a dire certainty as the data were being collected. We who compiled this budget and you who read it know it isn't so. There will be no such amounts of money as are printed in these pages, spent by the electric utilities for capital construction in 1945. Nor can the figures in this issue be regarded as expenditures deferred to some future time. When the day comes for major expansion to be considered again as of the immediately foreseeable future, the figures will probably be revised—upward we hope—by conditions obtaining then.

But this is not to say that the data of 1945 contemplated expenditures have no value. On the contrary they have great value. They are an authoritative estimate of what the utilities are ready to undertake to extend and improve their service to the people as soon as they can. They are a part of the firm promise of business enterprise to furnish employment and to improve the American standard of living when war demands subside.

In June of 1940 this magazine published an editorial feature entitled "Dinner Pail Dollars" which showed in detail how the money, some $600 million, spent by the utilities for new construction that year multiplied itself many times as it moved from hand to hand in the economy of the nation. It showed how creative expenditures spread out to benefit many more than those who receive the first pay envelope in the chain; it demonstrated the ever-expanding building power of capital investment. Right now the nation is investing its capital in destruction, but we shall sometime return to building again. When that day comes the "Budget That Might Have Been," and more, too, will be ready to take up its constructive work.

Distribution Continuity

GIVING EVERY ELECTRIC CONSUMER absolutely uninterrupted service year in and year out is a physical and economical impossibility. Yet giving residential customers a service which means on the average a brief interruption once in two years is both feasible and worth striving to equal or outdo. Especially if the interruption is on the average so brief as to amount to as little as two-thirds of a minute.

Those are figures culled from a system that keeps a record of outages, where the trouble originated, how long each lasted and how many users were affected. From such data it is practicable to allocate the number and duration of outages against significant components of the system. Various indexes can be computed to show comparative or progressive results and these are indispensable for showing where effort should be applied in working toward superior performance.

One company has already emphasized the fact that the heavy part of the investment per customer lies between the transformer and the meter. That company or another might be able to show, with data on the outages available for analysis, that an insignificant part of the interruptions is due to the secondaries and service wires, whereas a large fraction is due to primary mains and feeders. It may make sense—other factors may be at the bottom of this inconsistency—but it is worth looking into. Why, in short, should more investment have to be allocated where hazards to continuity are demonstrably least?

If little can be done to reverse the figures it will probably necessitate better coordinated measures for protection of distribution against faults that lead to durable interruptions. Any record that shows distribution to be blamable for six times as much of the customer-hours as substations and supply or 60 times as much as generation and transmission should precipitate some fundamental analysis regarding where to spend money for present and future loads and what to spend it for—particularly if continuity is destined to be more than ever called for as a requirement for post-war loads.

Metric System

ONE ISSUE that is sure to be raised after the war is the one of more definitive adoption of the metric system of weights and measures. Millions of our men will be coming back from areas where they will have found everything expressed in decimal multiples. Some of them are sure to like the simplicity of it all but others, held by long-standing familiarity, are pretty sure to be content with a continuance of the feet, quarts, acres, and the various kinds of tons, miles and ounces that mark our scheme of measurement.

Meanwhile manufacturers and plant workers right here at home will have acquired added experience with metric measurements through the production of military supplies for our allies under lease-lend. Incidentally our own army uses 55, 105 and 155-millimeter guns and we have to make them here, too. Prospect for increased foreign trade is still another angle that will focus attention on the long-deferred decision.

Shall we stick to the system we have evolved and retain the benefits of long-standing accustomedness? Or shall we switch to a system that many nations observe because it is as simple in its decimal gradations as our money designations—the nearest approach that we have granted ourselves other than the electrical units in common use.

Those electrical units are c.g.s. and metric in nature and that is a reason why the electrical industry is one that should be making up its own mind on a broadening of application so as to be ready to take a stand whenever the question culminates in an issue. It probably will not be a fatal or even fateful decision either way but if it is ever going to be settled it should be settled when this war ends. There are right now factors of timeliness which point up the arguments.

If those advocating the metric system are not potent enough to win a commanding majority at this significant juncture then they will have to call their crusade a dormant cause for a long time until an equally determinative era arises.

Highway Lighting Challenge

IN SIGNING THE BILL for $1.5 billion for federal aid in building state highways last month, the President termed the enactment of the legislation a "challenge" to the states, countries and cities which must originate the projects to which aid will be extended.

The picture of post-war highway building and improvement includes other originators than just those the President had in mind when he called the act a challenge. These other originators are the men and interests who promote the ideas, materials and equipments for incorporation into highway design. To these, the annual appropriation of $500 million of federal aid in highway building for three years is also a challenge.

We'd rejoice mightily if we could say with truth that the present effort of the Street Lighting Section of NEMA to promote highway lighting is an acceptance of the challenge. It is not. It is hardly the beginning.

Engineers of many utilities are keeping in close contact with developing plans for post-war highways in their various states. They are concerned with the problems that will arise in relocation of transmission and distribution lines and in classes of line construction that may be required. These are subjects of discussion at meetings of utility engineers. To that aspect of highway planning the utilities are fully alive.

Allocation to lighting of a small fraction—indeed, a *very* small fraction—of the hundreds of millions of dollars that will be spent on highways would save lives and avoid personal injury and property damage, not to speak of boosting sales of electricity.

Until the utilities see, investigate and plan to take profit from the opportunity to light the projected network of highways to which federal aid of $1.5 billion will be given, it can not be said that the electrical industry is taking up the challenge such aid offers.

Restrictions Return

EXIGENCIES arising from fluctuating military confidence have been the occasion for resumption of coal conservation and cancellation of many of the tacitly authorized programs of civilian goods production. Since we must apparently step up not only the number of men in the forces but also the production at munitions plants the inadequacy, if not insufficiency, of manpower is in focus anew. It all adds up to more 4Fs in essential places, more 68Fs on the thermometers in homes and offices and fewer f.c.'s on the signs.

Whether coal production last year was ahead of the previous year or not is an argued point. But there is not much point in arguing that more draft for the military services is certain not to make more coal miners available. So, in keeping with all other restraints that are applied and enforced, there should and will be whole-hearted effort on the part of the utilities to conserve their coal reserves and consumption. Hydro will, as always, be utilized to the practicable limit and turbine units will be scheduled for maximum plant efficiency and minimum fuel consumption.

When it comes to the dousing of signs and store-window illumination one of the welcomed clauses of the Byrnes' proclamation is that which suggests that the supervision and enforcement be placed in community hands. With the utilities usually required to serve all comers it is regulation in reverse to assign curtailment responsibilities to them. If civilian defense organizations have been too completely disbanded, why should not the local municipal authorities charge the police departments with the task of enforcing the conservation rules? Utilities generally should welcome such a turn.

WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

Federal Power Pattern Presaged for Northeast

THE ANNOUNCEMENT that the "Middle Atlantic Power Administration" plans a 220-kv. line North from Pennsylvania to tie into the system of the "New England Power Administration" has not yet been made, and won't be for some years—perhaps it never will be under those names and that voltage.

River Studies

But unless Congress utterly reverses itself, something of this nature may be expected within a decade, and the prospects that Congress will reverse itself on the existing federal power marketing policy are currently nil.

The Army engineers' plan for development of the Upper Potomac River has not yet been sent to Congress, to be sure, and the sections of the recently enacted Flood Control Bill which authorized 205,000 kw. on Pennsylvania's Juanita and Youghiogheny rivers were changed to authorize merely further study. But many Connecticut River Basin projects are already authorized.

The provocative point of all this is that whatever new marketing administrations spring up will do so under the aegis of the Interior Department, which, for the next four years at least, is committed to an aggressive anti-private power philosophy. Eastern power companies which have been content to regard the Mississippi River as a solid barrier against "those western goings-on" must now realize that the Flood Control Bill of 1944 is law, and that thereunder the Interior Department markets the power generated at War Department dams. None of the dams have yet been appropriated for, but unless there is a major revolution in Congress before the end of the war, this point is academic.

There are the makings of a Southeastern Power Administration to the South and East of TVA, where two projects with an ultimate capacity of more than 800,000 kw. are already authorized. Three more projects in that general area, totaling almost 1,750,000 kw. ultimately, are under study, one of which missed becoming law only because members of the 78th Congress were more anxious to get home for Christmas than to argue further about a minor amendment to the Rivers and Harbors Bill. Under federal power policy, the output of these dams will be marketed by the Interior Department, which already operates the Bonneville and Southwest Power administrations.

Eager for Steam

Southwest already is studying its future in terms of the Flood Control Bill. Since its Grand River Dam must be returned to the State of Oklahoma when the war emergency has passed, and since its control over the output of Denison and Norfork dams was based on executive order rather than law, there were some who questioned the future of SPA. Whether SPA markets Grand River's output after the war—and the State conceivably could be more than happy about such an arrangement—SPA will have Norfork and Denison, with 70,000 kw. now and 220,000 kw. more to come under the Flood Control Bill, plus Blakely Mountain Dam in the Ouachita Basin of Arkansas, the Arkansas River Basin and the White River Basin projects, ultimate capacity totaling almost 500,000 kw.

Interior has long been known to be interested in certain government-owned steam power plants now operated in conjunction with war industries. It will, as a government agency, get preference in obtaining those plants it needs when they are declared surplus. Within 300 miles of Norfork, Grand River and Denison are 17 such plants whose capacity totals more than 400,000 kw. Not all will be declared surplus and many are located far beyond the confines of the largest area in which SPA might be expected to be interested. The point is that SPA is no war baby, and that when it can obtain materials for transmission lines after the war, it will, by federal law in the Surplus Property Disposal and Flood Control acts, be in a position to build itself a system of major proportions.

That SPA, or any other Interior-controlled marketing agency, will be at all anxious to tie itself up to private electric companies any more than is necessary is doubtful at best, judging from the strained relations between Bonneville and the private companies of that region. SPA, which obtains a certain amount of back-up for its hydro capacity from private companies now, is known to be negotiating to obtain the government-owned floating power plant which has been in use in the Southeast for about a year. It hopes to anchor the floater in the Mississippi and move the power across the Arkansas Power and Light Co. system by "common carrier" use of Arkansas Power & Light facilities, for delivery to its own system. With the possible exception of the "common carrier" transmission, all this is within SPA's right.

Who Markets MVA?

Thus, if Interior's two existing power marketing administrations pursue trails leading away from cooperation with private power, it is reasonable to assume that whatever new agencies Interior sets up to market energy to be developed in the future will pursue the same trail.

Next step in the Ickes program is to obtain jurisdiction over the power developed in the Missouri River Valley, an objective already partially accomplished, since if no Missouri Valley Authority is established, any power developed will be by Interior or the Army engineers, and the latter's output is, under the Flood Control Bill, marketed by Interior. From the standpoint of sound governmental administration, there is argument as between the local autonomy heralded by TVA, and the centralized administration promoted by the Bonneville Power Administration. This issue will face Congress if it determines that the Missouri Valley should be developed by a regional authority rather than by old-line federal agencies.

NEWS OF THE WEEK

U-9 to Save Electricity to Become Effective, Feb. 1

Order Prohibits with Few Exceptions All Outdoor Lighting for Decorative and Advertising Purposes and the Lighting of Show Windows—At Suggestion of Industry Leaders, WPB Will Be Enforcement Agency

Order U-9, forbidding the use of electric energy for outdoor advertising, display, promotional, decorative and ornamental lighting, was issued by WPB this week to become effective February 1.

Issuance followed a statement by President Roosevelt, who said he was "particularly gratified to learn that the industry advisory committee of the Office of War Utilities had at its meeting last week indicated its wholehearted cooperation."

"In view of the request that occupants of homes regulate the temperature at 68 deg.," Mr. Roosevelt added, "it was essential that the WPB prohibit outdoor advertising, ornamental and display lighting, which should save approximately 2,000,000 tons of coal annually."

U-9 provides that no person shall use electricity for:

Outdoor advertising and promotional lighting; outdoor display lighting unnecessary for the conduct of outdoor business; outdoor decorative and ornamental lighting; show window lighting unnecessary for interior illumination; marquee lighting in excess of 60 watts per marquee; white way street lighting in excess of the amount deemed necessary by local authorities and all outdoor sign lighting except:

Direction and identification signs for fire, police and traffic control, transportation terminals and hospitals; directional or identification signs for similar essential public services specifically certified necessary by local authorities; and directional or identification signs of not more than 60 watts for doctors, hotels and other public lodgings.

It allows electric suppliers—which includes sub- and master metering agencies—who feel that compliance will not save coal or other scarce fuels to apply to OWU for exemption, and allows OWU to grant whatever area exemptions it deems proper. Individuals may ask exemption from their regional WPB offices.

Electric suppliers are required to notify all their customers who are affected by the order but may do this by advertisement in a newspaper of general circulation if necessary.

Electric suppliers are required to notify known violators; and, if the violations be continued, notify them again, in writing, specifying the section of the order in question. Copies of written notifications of continued violation are to be sent to the regional WPB office. When WPB determines that a violation has been committed, it may direct that service to the violator be cut off and prescribe conditions upon which it may be restored. Normally, restoration will be granted upon written promise that no further violation will be committed, it was learned.

Concealment of material information or furnishing of false information is declared a crime, punishable by fine or imprisonment. Effective date of the order, except that paragraph forbidding use of energy for the stipulated uses, was January 15, the date of issuance. Effective date of the paragraph forbidding energy use for stipulated purposes February 1.

As issued, the order puts the burden of compliance upon customers and lays the burden of enforcement largely upon WPB. This is accomplished by leaving out of the order a prohibition upon the furnishing of energy for proscribed uses and by requiring WPB to issue any disconnect orders which may be issued. This was suggested by industry leaders at last week's meeting with OWU officials as a means of minimizing customer-relations problems which might arise.

Estimates of revenue losses which will result from the brownout ranged from $40,000,000 to $75,000,000 annually, of which relatively little would come out of net income of any company paying excess profits taxes. The lower figure was derived by assuming that the load to be dropped would come from the most inefficient plants in normal operation and by assuming also that the decreases in consumption would be in the lower-cost end of the rate schedule. On the asumption that the load to be dropped would require 2 lb. of coal per kw.-hr. and would bring in 2 cents revenue per kw.-hr., annual coal savings of 2,000,000 tons of coal would result in a $40,000,000 revenue loss.

Lyons Temporarily in Charge

Early this week, OWU had not begun to assemble a permanent organization to administer U-9. Pending establishment of such a staff, the program was directed by William A. Lyons, assistant to the President of the New York State Electric & Gas Corp. and formerly chief of OWU's Fuel and Allocations section, and by Walton Seymour, director of TVA's Division of Power Utilization.

One of the factors precipitating the broad coal conservation demand voiced last week by War Mobilizer James F. Byrnes, it was learned, was the impending cancellation of 3,000 of 5,000 occupational draft deferments now held by coal miners between the ages of 22 and 26. Proportionate cancellation of deferments in the 26-30 age group also was anticipated. On the basis that these men produce 33 tons per week apiece, production losses from the 22-26 group would amount to 5,000,000 tons yearly.

WMC Rates Utilities as Critical Industries

Power Company Employees Between 26 and 30 Less Likely to Be Inducted Than Other Workers

Electric light and power utilities are classed as critical industries in a revised list of essential activities issued this week by the War Manpower Commission.

Under this classification, electric utilities will get more protection for draft-eligible workers between 26 and 30 years of age than will industries classed merely as essential.

WMC's revision of its long-standing essential activities list came as War Mobilization Director James F. Byrnes ordered selective service to set up a priority system for induction of industrial workers between 26 and 30 in such a way as "to minimize as much as possible the effect on essential activities."

Under the withdrawal plan outlined by Byrnes, inductions of men 26 to 30 will be as follows:

1. Registrants not employed in industries designated as essential by WMC.

2. Registrants holding relatively unimportant jobs in industries designated essential but not critical, and registrants who may be replaced without difficulty.

3. Registrants holding relatively unimportant jobs in critical industries and those replaceable without difficulty.

4. Registrants holding relatively more important jobs in essential activities.

5. Registrants holding more important jobs in critical industries.

Tree trimming for power lines was retained as an essential industry but was not classified as critical. In-plant maintenance and repair of industrial machinery were listed as critical, but repair of electric appliances and motors was listed only as essential.

Under the plan outlined by Byrnes tree trimmers would be called under the second step, but the calls from electric utility organizations would come under steps three and five. All technical, scientific and research personnel engaged in any industry on the list, whether critical or only essential, are to be regarded as being engaged in critical activity.

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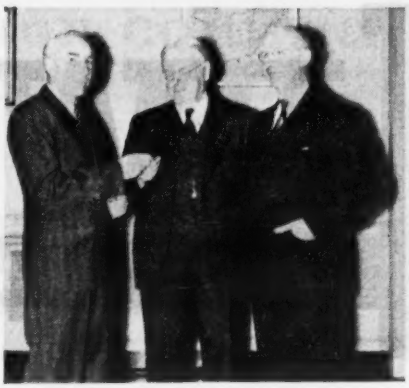
Eaton Plant Ready Soon

Mississippi Power Co. expects to put its Eaton plant into operation within a few months. The 30,000-hp. steam turbine will be the largest in Mississippi.



VETERANS RECOGNIZED—Fred H. Sargent (center), president of the Lawrence (Mass.) Gas & Electric Co., and a pioneer utility leader in the Bay State, with Frederick H. Harmon, assistant treasurer of the company, receive service pins from Irwin L. Moore, president New England Power Association. Mr. Sargent and Mr. Harmon have completed 55 and 50 years, respectively, with the company

LaGrande Power May Go to Tacoma in February

Date when Tacoma, Wash., will receive first electric power from the enlarged LaGrande plant of the $23,000,000 Second Nisqually project was tentatively set as early February by Chief Engineer Verne Gongwer when contractors failed to meet the December 31 deadline schedule set last October.

Fears that recently completed Alder Dam will fill before completion of the LaGrande tunnel, causing water to spill at a further loss to the city, also were expressed by Mr. Gongwer in a report to Tacoma Utilities Commissioner C. A. Erdahl.

Scheduled to be completed over a year ago, the project has cost the city nearly $2,500,000 more than originally planned. In his recent report, Mr. Gongwer expressed the opinion that a tendency toward minor economies by the contractors, without regard for the city's great losses, has been the chief reason for delay rather than a shortage of labor.

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Utility and Co-op Agree

Arkansas Power & Light Co. and Ashley-Chicot-Union rural electric cooperative have reached an agreement over distribution of rural areas in Ashley, Chicot and Union counties. Arkansas Department of Public Utilities has approved the agreement which provides for about 200 miles of new lines by the utility and about 800 miles by the co-op.

FPC Order Leads to Usurpation Charge

The move by the Federal Power Commission to bring three New York natural gas companies under its jurisdiction has brought from Milo R. Maltbie, chairman of the State Public Service Commission, charges that FPC is attempting "to usurp power over intrastate commerce."

Maltbie's charges were made less than two weeks after Basil Manly, FPC chairman, in a letter to Governor Andrew F. Schoeppel of Kansas, who is chairman of the Intrastate Oil Compact Commission, declared:

"We wish to assure the representatives of all the gas producing States that the Federal Power Commission has no desire to extend its jurisdiction to cover the production of natural gas or otherwise invade what are properly regarded as the functions of the conservation authorities of the several states."

Manly's letter was brought about by what he termed a "misunderstanding regarding the investigation of certain phases of the natural gas industry" which the FPC had ordered a short time before.

The New York companies, called by Maltbie purely intrastate companies, are the Pavilion Natural Gas Co., Southern Tier Gas Corp., and New York State Electric & Gas Corp. Each was informed by FPC that it is "a natural company within the meaning of the National Gas Act."

FPC demanded that each company comply with the uniform system of accounts prescribed by the Federal agency for natural gas companies, according to Maltbie, who asserted that each is already completely regulated by the state commission.

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$4,655,807 Budget Approved

Public Service Corp. of New Jersey has authorized a construction budget of $4,655,807 for its electric department for 1945. Major expenditures will be for the further improvement of facilities for generating, transmitting and distributing electricity to continue to meet war production requirements.

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Co-op Sells Retail Store

Wisconsin Electrical Cooperative has sold its retail store in Madison to the Wisconsin Electric Appliance Co., a newly incorporated firm, but will continue to operate electrical distribution systems throughout Wisconsin.

REA Co-ops Add 110,210 Customers in Fiscal Year

Report to Congress for Period Ended June 30, 1944, Shows Rapid Progress Despite War—10 Systems Energized and 16,114 Miles of Line Erected—Strong Financial Position Allows Advance Payments of Loans

Rural Electrification Administration cooperatives added 110,210 customers to their lines, boosted their average revenue per mile for all systems by $1.03, increased average consumption per month from 64 to 71 kw.-hr., raised gross income 17.4 percent to $25,563,643 and increased kw.-hr. billings 22.6 percent to 1,791,608,000 during the fiscal year ended June 30, 1944, REA's annual report to Congress showed this week.

Ten new systems were energized during the year, bringing to 815 the number doing business last July. Miles of line energized during the year totalled 16,114, bring the overall total to 397,861 miles.

Co-ops continued to pay interest and retirement charges ahead of schedule, the report showed, with advance payments of $16,807,254 by 599 borrowers in the fiscal year, an increase of more than $4,000,000 over advance payments by 555 borrowers during the fiscal year ended June 30, 1943. Delinquencies of more than 30 days increased during the last fiscal year from $181,125 to $277,387.

War Improved Co-op Finances

"Wartime conditions account for part of the large prepayments made by borrowers," the report declared. "In common with all other utilities, REA-financed systems were forced, because of the shortages of labor and material, to postpone many needed replacements and other maintenance work that they had planned. This pressure of maintenance demands, will, naturally, increase as the lines grow older.

"Operating reports filed by REA borrowers, including REA-financed lines of public agencies or private corporations in addition to those owned cooperatively, show that, on the average, management has had to write off as uncollectable not more than 25 cents of each $1,000 of bills during the 1944 fiscal year. . . . Borrowers did a business totaling $59,231,942 during the fiscal year 1944, an increase of $7,404,979 over 1943. In other words, they grossed 16 percent on investment in 1944, against 14 percent in 1943," the report declared.

In transmitting the report to Agriculture Secretary Claude R. Wickard, Harry Slattery, then administrator of REA, noted that the increase in average monthly consumption in the absence of new "luxury" appliances made the conclusion "inescapable that farmers increasingly put their electric service to work in productive ways."

"Applications for rural electric service from large power consumers continued in volume," Slattery said. "However, the emphasis was shifted from training stations, flying fields and armament plants to food and fiber processing industries. This is a favorable indication for the development of rural industries and a stabilized rural community."

"Well over 100,000 farms" were approved for connection by WPB during the year, of which 67,070 were approved under order U-1-c.

Allotments for acquisition of existing systems during the year totaled $6,851,796, covering 1,999 miles of line serving 22,311 customers. They will enable, when materials are available, the construction of 5,085 miles of new line at a cost of $4,824,584 to serve 12,597 additional customers.

Allocations for locker plants during the year totaled $362,000. The year's lending activities brought REA's total to $498,811,446, of which $387,630,670 has actually been advanced. Loans advanced during the fiscal year totaled $18,478,088. Allocations during the year totaled $31,930,123 for 34,602 miles of line.

REA helped co-ops renegotiate wholesale power contracts to effect annual savings of $150,000.

Prospects for future increases in average monthly consumption are bright, the report declared with the statement:

"The prediction can safely be made that power consumption in the 300 to 500 kw.-hr. per month bracket will be typical of many high-producing farms in the early post-war period. More important, from the standpoint of the economic security of REA-financed systems, some managers look forward to average monthly consumption of all members on their systems rising to 200-kw.-hr. or better when appliances and equipment—some still in the blueprint stage—come on the market in large quantities again."

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OWU Approves Turbine

Office of War Utilities has approved installation of a 45,000-kw. steam turbo-generator at the South Meadow plant of the Hartford Electric Light Co., Hartford, Conn. The unit is to go on the line early in 1946. The job does not include any boiler installation.

JAP PLANT REPAIRED—Two 250-kva., 50-cycle diesel-driven generators captured from the Japs were repaired and assembled by Navy personnel after the plant had been under severe shell fire. The generator exhaust was piped through a pontoon box used as a muffler. A pole line was built from sawed-up 80-ft. spiles, crossarm braces being cut by torch from angle irons. Bolts were made by blacksmiths from cold-rolled steel taken from Jap stock. The picture was furnished by "Contact," magazine of the New England Power System

Cleveland Strikers Return to Stations

Walkout at Electric Illuminating Co. Arouses Public and Unions—Army Took Over System

Operations of the Cleveland Electric Illuminating Co. are nearing normal after the most serious curtailment of power in any city of the United States during the war.

An unauthorized strike of members of the Utility Workers Organizing Committee, Congress of Industrial Organizations, lasted but 16 hours before the army, in charge of Colonel E. A. Lynn, Cleveland ordnance district chief, took over, and the strikers returned to work. The army held the plant for nearly 60 hours, from early Saturday morning, January 13 to last Monday afternoon.

The beginning of the strike was the transfer of Victor Stemberger, boiler operator and union steward of the Canal Road steam plant, from the day to the night shift. Stemberger did not report as directed but again reported for work on the day shift. When he was ordered home, the strike began and spread rapidly to other plants. Stemberger is back at work but has been reclassified as 1-A by his local draft board. On December 28, the 29-year-old man was given a six-months' occupational deferment as a 2-B.

Union Presents 9 Demands

When negotiations began with company officials before the army took over and put an end to the proceedings, the local union leaders presented a nine-point program of demands. Included in these was the one for a seven-cents an hour raise which was recently disallowed by the War Labor Board. Of the nine points only one is still to be arbitrated, this concerns compensation for workers temporarily or permanently assigned to do work of a higher classification.

C.I.O. and other union leaders are pressing an investigation of the strike because it violated labor's "no strike" pledge and aroused the anger of Cleveland residents and army and navy officials alike. Alan S. Haywood, national director of organization for C.I.O., has requested the removal of Harold J. Straub, national director of U.W.O.C., and Leonard E. Palmer, president of Local 270.

Haywood said that he had learned that the strike was not spontaneous but was well planned and that Straub and Palmer had refused to order the men back to work but insisted on first negotiating.

The strikers threw picket lines around the Avon, Ashtabula and Lake Shore generating stations of the company, serving 357,000 industrial and domestic consumers in a five-county area. As groups of operating and maintenance workers progressively joined the walkout, power output sagged until the company asked war plants, in order of their essentiality, to reduce consumption from 50 to 75 percent.

Compliance reduced the generating load to 210,000 kw. from a peak of 582,000 kw. Full coal bunkers at the start of the walkout obviated further reduction.

Exact loss of production because of the strike is difficult to estimate, but army and navy officers in charge of work at war plants place the figure at approximately 1,000,000 man-hours.

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State High Court Backs Utah Power Rate Slash

More than a year's controversy over rates charged by Utah Power & Light Co. appeared ended for the utility's customers who, in mid-January, were scheduled to begin receiving $1,850,000 in refund checks. A Utah Supreme Court order early in January released the funds which have been impounded since September, 1943, when the State Public Service Commission ordered a reduction in the rates to be charged by the company.

At the same time the court ordered the State Tax Commission to refund sales tax paid by U.P. & L. on the impounded sum. Following the rate reduction order in 1943, the company appealed to the Supreme Court which upheld the commission's order in October, 1943.

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Virginia Utilities Need Not Pay Rate-Making Levy in '45

The special tax levied by the state of Virginia against utility corporations for rate-making purposes will again be dispensed with in 1945, the Virginia Corporation Commission has ruled.

The tax of .02 of 1 percent was first levied in the early years of the depression to defray the costs of rate investigations and other items of expense in connection with revisions in rates.

By 1940, the fund had grown so large that the commission was authorized to dispense with the levy whenever the fund is deemed sufficient for the coming year.

Independent REA Bill Introduced in Senate

A bill to re-establish the Rural Electrification Administration as an independent agency was introduced this week by Senators Henrik Shipstead, Minnesota, and George D. Aiken, Vermont, both Republicans, and Senator Burton K. Wheeler, Montana Democrat.

The measure was referred to the committee on agriculture and forestry which last year conducted an investigation of the agency and reported favorably on independence for REA.

The bill would forbid the Agriculture Department, under which REA now functions, to exercise any control over the agency after 30 days after date of enactment.

Laid before the Senate at the same time by Senator William Langer, North Dakota Republican, was a resolution adopted recently by the Tennessee Rural Electric Cooperative Association, including TVA- and REA-sponsored co-ops buying energy from TVA, which urged immediate favorable action on the bill and asked that the Agriculture Committee's investigation, which ended last summer, be continued. It asked further that REA officials charged during the investigation with shortcomings be given an opportunity to be heard and that the Agriculture Department be required to show what it has done to establish innocence or guilt of such REA employees.

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Emergency War Power Now Only .1¢ per Kw.-Hr.

The lowest rate on record in either the United States or Canada, one mill per kw.-hr. has been ordered by the New York Public Service Commission for utilities in Western New York getting war emergency power from Niagara Falls Power Co. The new rate was effective January 1. In 1944, the company complied with a previous order of the commission reducing rates $1,000,000.

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Ohio Municipals Rebate

Four Ohio municipal light departments have given consumers "paid" bills for periods of a month or more in accord with recent action.

The communities are Elmore, December bills, totalling $2,600, for 482 customers; Columbiana, October, November, and December bills, totalling $12,000; Westerville, December, no amount given; Norwalk, one month voted on January 2.

Pennsylvania Admits High Utility Taxes in Rate Case

Public Utility Commission in Ruling That Rates of Pennsylvania Power & Light Co. Are Not Excessive Declares That High Federal Taxes Are to Be Expected in Future and Must Be Taken into Consideration

Current and prospective high tax rates in determining the rates of an electric utility have been recognized by the Pennsylvania Public Utility Commission in an order which held that the rates of the Pennsylvania Power & Light Co. are not excessive. Two complaints against rates charged by the company were dismissed.

The commission also approved an aggregate rate base of $220,500,000 and set 6 percent as the proper rate of return on the electric branch of the company which serves a large section of the central and eastern sections of the state including Allentown, Bethlehem, Harrisburg, Lancaster, Wilkes-Barre, and Williamsport.

"Fair Value" Principle Used

The commission, in determining the rate base for the company, adopted the principle of "fair value" based on a decision of the Pennsylvania Superior Court in Peoples Natural Gas Co. v. Public Utility Commission in 1943 in which the court said, "Even the severest critics of the present value doctrine conceded that capitalization is ordinarily no evidence of value," adding that the utility "is entitled to earn on the basis of the fair value of the property presently dedicated to public use."

"The question of treatment of Federal income taxes is one of the most controversial subjects in rate regulation at the present time," observed John Siggins, Jr., commission chairman.

The majority opinion stated that there has been a rather widespread tendency to allow for rate purposes only the normal tax of 24 percent which was in effect in 1940, on the theory that the surtax and excess profits tax, subsequently enacted, are wartime emergency taxes and hence improper measures of future tax costs.

"Our objection to this view," said the commission, "is that the governmental debt now being accumulated as a result of war financing will require peacetime taxation for its servicing and repayment; and although tax rates may not continue at their present levels, a return to anywhere near the 24 percent rate appears most unlikely for many years to come."

Attention is called to the two methods, average earnings and invested capital, for computing excess profits subject to tax.

"Neither of these methods is reconcilable with the principles of rate making as laid down by our courts," declared the majority opinion. "Thus, respondent's (Pennsylvania Power & Light) earnings have increased over the 1936-1939 average, but so also has its investment in plant.

"Assuming for the moment that the increase in earnings and plant investment were exactly proportional, respondent could not use the average earnings method to escape the excess profits tax. Neither could it do so under the invested capital method, for plant investment and outstanding securities usually approximate each other, but the method of determining invested capital under the Revenue Act, the outstanding securities are automatically discounted to the extent of 50 percent of the funded debt. Consequently, any fair value of plant in line with court decisions must be considerably in excess of 'invested capital' for any utility which is financed fairly heavily with indebtedness, and it follows that allowable return in a rate case must be likewise considerably in excess of allowable return upon invested capital for tax purposes.

"Hence," continued the order, "the only way for a debt financed utility to escape the excess profits tax in the face of an increasing investment in plant is to receive no return on the increased investment. This is manifestly unfair, particularly inasmuch as most utilities, respondent among them, have increased their plant investments to provide the materials of war at the urgent request of the Federal Government.

"There is one further point which appears worthy of consideration. The position of the court, and consequently of this commission, has been that a public utility is entitled to earn a fair over-all return upon its plant, and that if it can finance a part of that plant with low-cost borrowed money, the fact that the stockholders thereby get a larger-than-fair return is not a justification for reducing the rate to the customer."

The commission pointed out that the customer has never been given the benefit of lower rates when a utility financed its plants on borrowed money and said: "The question before us is as to whether the rule should work both

FORTIETH ANNIVERSARY—On Christmas morning 1904 J. J. Caddigan rang a Boston Edison official's doorbell to apply for a momentarily vacant job as driver, and was accepted for a week's trial. Recently his fortieth anniversary with the company was observed by the presentation of a diamond service pin by President James V. Toner. Mr. Caddigan is now assistant vice-president and promotion manager. Later in the day, members of the promotion department offered their congratulations to their chief. In this group are, standing, left to right, B. W. Robertson, advertising manager, S. W. Wilson, H. J. Fitzgerald, Vice-President T. H. Carens, J. F. Harvey, G. Panza, P. J. Waterman. Seated, left to right, Nancy Burke, Gertrude McCourt, Alice Maher, Emma G. Tighe, home service director, Mr. Caddigan, Eleanor Mansfield, Mary McCabe and Virginia Comstock.

ways—that is, whether, when tax legislation is enacted which penalized previously-advantageous financing, that penalty should be placed upon the customer to whom no corresponding benefit inured. We think the rule should work both ways, and our allowances for taxes will be premised on the assumption that a public utility is financed entirely with equity securities, when that assumption will be of benefit to the customer."

In a dissenting opinion, Commissioner Thomas C. Buchanan held that excess profits taxes are properly a charge against income and not an expense and states that this policy "seems to be the overwhelming trend of utility regulation at this time." He cited decisions by regulatory bodies in Alabama, Arizona, California and Michigan as well as by the Federal Power Commission. Attention was also called to a paper read by Dr. C. O. Fisher, chairman of the Connecticut commission, supporting this view before the National Association of Railroad and Utilities Commissioner's convention in 1943.

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New Hampshire Company Will Give Month's Refund

Over 85,000 residential and farm customers of the Public Service Co. of New Hampshire are to receive a refund this month equivalent to the price of electrical energy consumed by them in December, 1944. The total is approximately $330,000, and the decision to make the refund followed conferences between the state public service commission and representatives of the company.

To a representative of ELECTRICAL WORLD, President A. R. Schiller stated last week that about $30,000 will also be refunded to large power users who receive service under a fuel clause, this action has been taken in recognition of the point that a fuel clause should not be applied to energy generated by hydro. The refund may be paid in cash or in the form of a credit on all bills presented after January 1 at the option of the company. Chairman Edgar H. Hunter of the New Hampshire commission announced the board's authorization of this step.

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Reelected in Tennessee

Porter Dunlap was unanimously reelected chairman of the Tennessee Railroad and Public Utilities Commission for a two-year term at the reorganization meeting of the Commission.

Larger REA Loan Fund Asked by F.D.R.

Budget Also Asks Appropriations for Other Federal Bodies Concerned with Power Activities

President Roosevelt has recommended to Congress that loan authorizations for the Rural Electrification Administration for the fiscal year ending June 30, 1946, be increased from $25,000,000 to $150,000,000.

Under the REA Act, the agency is authorized to borrow from the Reconstruction Finance Corporation specified sums which it in turn lends to cooperative borrowers. In justification of the expansion, the budget states:

"An increase from $25,000,000 to $150,000,000 is provided for loans for rural electrification so that this program, which has been necessarily curtailed by the war, may be resumed at an accelerated pace if materials and labor become available."

FPC Asks Lesser Amount

Budget estimates for the Federal Power Commission for the fiscal year of 1946 totalled $2,468,850, a decrease from appropriations of $2,799,308 for the present fiscal year.

An increase of $153,000 in funds for administration of the Federal Power Act, according to the budget, "reflects the necessity for the resumption of certain of the commission's statutory duties which are being suspended or curtailed in order to divert personnel to the commission's war duties. These suspensions and curtailments were principally in connection with licensed projects, accounting matters, the extension of assistance to states and municipalities in handling regulatory problems, and work on comprehensive river basin studies in conjunction with other federal agencies. This increased volume of regulatory work is offset by a lessening of the commission's duties in connection with war-power contracts and plant protection surveys, as well as a lessening of work in collaboration with the War Production Board."

Funds For Other FPC Work

Other FPC appropriations include $135,000 for flood control surveys, a decrease of $9,500; $110,000 for national defense activities, a decrease of $490,000; and approximately $45,000 for technical administrative requirements.

In submitting a total appropriation of $4,279,000 for the Securities and Exchange Commission, a decrease of more than $400,000, the budget reported:

"Progress continued with the integration and corporate simplification of public utilities systems under the Holding Company Act of 1935. However, inability to recruit technical personnel, both on the part of the commission and the companies, has retarded this work during the war. It is expected that the commission's activities in this field will continue at approximately the 1944 level during 1945 and 1946."

REA's appropriation for 1946 was estimated at $3,400,000, an increase of $154,000 over that for the present year. This is for administration and is in addition to the requested $150,000,000 of loan authorization.

The budget estimated that $9,850,000 in new appropriations would be required for the Tennessee Valley Authority in 1946, in addition to the re-appropriation of $9,631,000 of unobligated balances.

Estimated 1946 appropriation for the Bonneville Power Administration was set at $3,500,000, for the Southwestern Power Administration, $110,000, and for the Bureau of Reclamation, $804,300. These sums are for administration and are exclusive of operating and construction budgets which are handled separately.

MEETINGS

Pennsylvania Electric Association—Transmission and distribution committee, Wm. Penn Hotel, Pittsburgh, Pa., February 15-16. M. M. Devorris, chairman, Pennsylvania Edison Co., Altoona, Pa.

Southeastern Electric Exchange—Engineering and operation section, Henry Grady Hotel, Atlanta, Ga., March 22-23. J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta 3, Ga.

Previously Listed

American Institute of Electrical Engineers—National technical meeting, Engineering Societies Bldg., New York, N. Y., January 22-26. H. H. Henline, secretary, 33 West 39th St., New York 18, N. Y.

Institute of Radio Engineers — Winter technical meeting, Hotel Commodore, New York, N. Y., January 24-27. W. B. Cowilich, secretary, 330 W. 42nd St., New York 18, N. Y.

Pennsylvania Electric Association—Systems operation committee, Penn Alto Hotel, Altoona, January 30-31; A. R. Deck, chairman, Metropolitan Edison Co., Reading, Pa. Electrical equipment committee, Hotel Roosevelt, Pittsburgh, Pa., February 8-9; B. E. Hagy, chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia, Pa.

Edison Electric Institute — Accident prevention committee, Cleveland Hotel, Cleveland, Ohio, February 8-9; electrical equipment committee, Netherland Plaza Hotel, Cincinnati, Ohio, February 13-14; transmission and distribution committee, Wm. Penn Hotel, Pittsburgh, Pa., February 15-16. Col. H. H. Bennion, managing director, 420 Lexington Ave., New York 17, N. Y.

American Society for Testing Materials—Committee week, Wm. Penn Hotel, Pittsburgh, Pa., February 26-March 2 (spring meeting, February 28). R. J. Painter, assistant to the secretary, 260 S. Broad St., Philadelphia 2, Pa.

Canadian Electrical Association—Annual Western conference, Hotel Vancouver, Vancouver, B. C., March 14-16. B. C. Fairchild, managing director, 704 Tramways Bldg., Montreal 1, Que.

Peru Plans Hydro Plants in 5 Sections of Country

An annual appropriation of approximately $2,000,000 has been approved by the Congress of Peru to finance preliminary work for a large scale national electrification program using as hydroelectric sources the rivers draining both sides of the Andes Mountains. A ten to twenty-year program is under consideration.

The completion of the 167,000-hp. Canyon del Pato project on the Santa River, being constructed under the direction of Barton M. Jones, a former chief planning engineer of the Tennessee Valley Authority, is included in the plans.

Other projects are hydroelectrics plants at Manseriche Canyon on the Maranon River, a tributary of the Amazon, in northern Peru; at Pongor, on the great bend of the Mantaro River south of the Cerro de Pasco mining district in the central mountain region; on the Urubamba River; and in the Lake Titicaca area.

All work is being carried on through the government owned Peruvian Santa Corp. of which David Dasso, a former minister of finance and once vice-president of the American Locomotive works is head.

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Sample Query to Service Men Sent Out by C.E.O.C.

A copy of the letter and questionnaire sent by the Florida Power Corp. and the Georgia Power & Light Co. to their employees in the armed services has been distributed by the Council of Electric Operating Companies to its members.

The questionnaire is designed to enable the former employee easily to supply information on his experiences and training in the service, his hopes for the future, and his service history.

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Power Co. Incorporates

Pisgah Mountain Electric Co., of Lincolnton, N. C., has been incorporated with authorized capital of $25,000 and subscribed stock of $5,000 to maintain electric lighting, heating and power plants. The principals include D. A. Kiser, Mrs. Mary Kiser and Miss Kate Kiser, all of Lincolnton.

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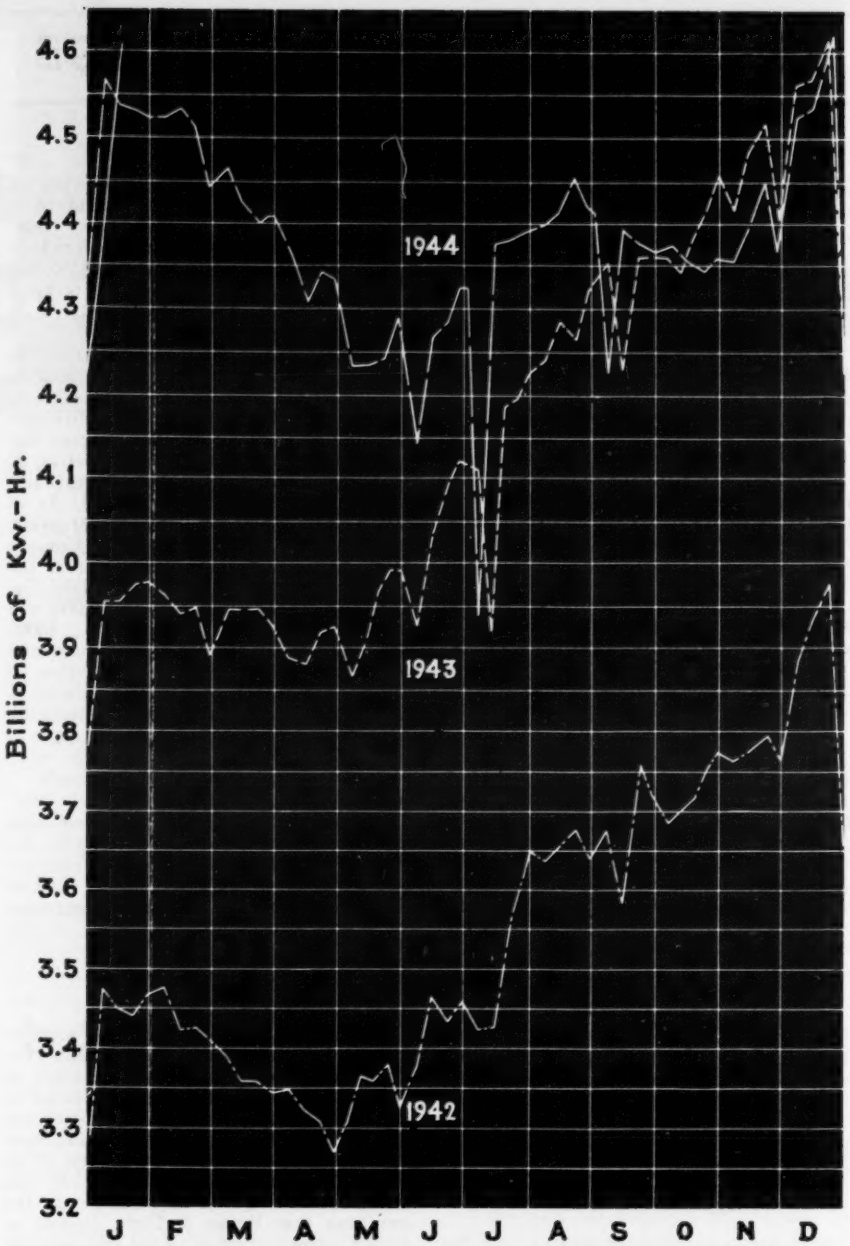
Columbus Re-enacts Tax

Columbus, O., has re-enacted its 5 percent tax on all 1945 utility bills. The measure is expected to produce $840,000.



Electric Output Curve Moves Sharply Upward

The electric output curve during the week ended January 13, 1945 swung sharply upward, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry amounted to 4,614,334,000 kw.-hr., as compared with 4,427,281,000 kw.-hr. during the preceding week ended January 6. During the week ended January 15, 1944, the amount of electrical energy distributed amounted to 4,539,083,000 kw.-hr., this year's figure representing an increase of 1.7 percent.

Four of the seven major geographic regions reported gains for the week ended January 13 as compared with the corresponding week last year.

Weekly Output Millions Kw.-Hr.

1945		1944		1943	
Jan. 13	4,614	Jan. 15	4,539	Jan. 16	3,952
Jan. 6	4,427	Jan. 8	4,568	Jan. 9	3,953
1944		1943		1942	
Dec. 30	4,226	Jan. 1	4,337*	Jan. 2	3,780†
Dec. 23	4,617	Dec. 25	4,295	Dec. 26	3,656
Dec. 16	4,563	Dec. 18	4,613	Dec. 19	3,976
Dec. 9	4,538	Dec. 11	4,567	Dec. 12	3,938
Dec. 2	4,524	Dec. 4	4,560	Dec. 5	3,884
Nov. 25	4,369	Nov. 27	4,403	Nov. 28	3,766
Nov. 18	4,450	Nov. 20	4,513	Nov. 21	3,795
Nov. 11	4,397	Nov. 13	4,483	Nov. 14	3,776
Nov. 4	4,355	Nov. 6	4,414	Nov. 7	3,762
Oct. 28	4,358	Oct. 30	4,453	Oct. 31	3,775

* 1944 † 1943

Percent Change from Previous Year

	Week Ending Jan. 13	Jan. 6	Dec. 30
New England	+ 3.5	.....	+ 0.4
Mid Atlantic	— 0.7	.....	— 5.1
Central Industrial	+ 3.4	.....	+ 0.7
West Central	+10.2	.....	+ 6.4
Southern States	+ 5.4	.....	— 1.7
Rocky Mountain	— 9.6	.....	—12.4
Pacific Coast	— 0.2	.....	— 3.8
Total United States	+ 1.7	.....	— 2.6

SEC DECISIONS—HEARINGS

The Securities and Exchange Commission, in a series of orders recently issued affecting utility companies:

HAS APPROVED proposed issuance and sale by South Carolina Power Co., Charleston, S. C., of $8,000,000 of first and refunding first mortgage bonds, due 1975, and $2,400,000 of 2¼ percent installment notes. The bonds are to be offered under competitive bidding. The notes are to be sold to banks. The commission also approved the donation to South Carolina Power for cancellation of $1,850,000 of outstanding first lien and refunding first mortgage bonds and 5,550 shares of its $6 preferred stock held by the Commonwealth & Southern Corp., its parent. Commonwealth would sell South Carolina for retirement $3,410,000 of the 5 percent bonds at its cost, $2,855,562. Proceeds from the sale of new securities would be used to redeem $4,600,500 of the 5 percent bonds at 102½ and retirement of 23,023 shares of $6 preferred at $110 a share.

POSTPONED INDEFINITELY hearings on the plan of liquidation of Americal Light & Traction Co., proposed by its parent, United Light & Railways Co. An argument over procedure developed when the hearings on the plan opened recently and the matter was referred to the commission. Oral argument has been heard and the commission announced that it will in due course hand down its tentative views on the question of procedure.

AUTHORIZED TWO protective committees for holders of preferred stock of the New England Public Service Co. to solicit holders for support of their views with respect to recapitalization of the company. One committee is headed by Arthur E. Spellissy of Philadelphia and the other by Lester Martin of New York.

Applications Filed

SOUTHWESTERN PUBLIC SERVICE CO. has filed a registration statement covering the proposed issuance and sale of $17,500,000 of 3⅛ percent first mortgage bonds due in 1974 and 50,000 shares of $100 par value cumulative preferred stock. The company proposes to exchange on a share-for-share basis 45,000 shares of the new preferred stock for its outstanding preferred stock. The remaining 5,000 shares of new preferred would then be sold to underwriters of the issue. The company also proposes to sell the securities of its former subsidiary, Gulf Public Service Co., and other properties for $4,875,763. Proceeds from the sale of the bonds, stock and properties, together with whatever sums is necessary from the company's general fund, will be used to redeem $20,000,000 of its first mortgage and collateral trust bonds, now outstanding at 110½, to redeem all outstanding preferred shares not exchanged for new preferred stock at $110 a share, and to pay expenses incurred in issuing the stock and bonds.

ASSOCIATED GAS & ELECTRIC CO. and the Associated Gas & Electric Corp. have notified the commission of their proposed allocation of proceeds from settlements of claims against John I. Mange, Sanford J. Magee, Marguerite H. Burroughs (individually and for the estate of Frederick S. Burroughs) and Daniel Starch, all former officers of the system. The claims resulted from alleged acts of mismanagement.

CONSOLIDATED ELECTRIC & GAS CO. has petitioned the commission for authority to raise $650,000 from three subsidiaries in connection with its plan for the retirement of all the outstanding 30-year 5 percent first lien and collateral trust bonds, Series A, due April 1, 1958, of Southern Cities Utilities Co., assumed by Consolidated. As of Jan. 5, 1945, there were $4,716,500 principal amount of bonds outstanding. Consolidated proposes to obtain funds from the subsidiary companies as follows: Haiti Co., $100,000; Santo Domingo Co., $250,000, and Roanoke Railway & Electric Co., $300,000. Payment by the subsidiary companies would be in the form of a reduction of principal on their respective notes owing to Consolidated. The proposed transactions are steps to provide Consolidated with some of the funds to discharge and retire its entire issue of assumed Southern Cities bonds.

OGDEN CORP. has asked the commission to permit it to sell at public auction approximately 54,000 shares of its common stock, unclaimed by their owners, and to authorize the holding company to purchase the shares at auction "if necessary to prevent the sacrifice of values."

Hearings Scheduled

JANUARY 26: To consider the application of Cities Service Power & Light Co. for an extension of time within which to comply with the January 7, 1944, order of the commission. The order in question approved the acquisition by Ohio Public Service Co., a Power & Light subsidiary, of all the outstanding common stock of the Marion-Reserve Power Co., subject to the condition that Power & Light dispose of certain water properties owned and operated by Marion-Reserve within one year.

FEBRUARY 6: On Columbia Gas & Electric Corp.'s reorganization plan, designed to meet integration requirements of the Holding Company Act, Columbia's existing preferred, preference and common stock will be reclassified into a single class of capital stock for distribution among holders of present stock. The Cincinnati and Dayton groups of subsidiaries will be separated from the Columbia system and their common stock distributed among holders of Columbia's securities.

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Evansville Renews Contract

Evansville, Ind., has voted to extend its street lighting contract with the Southern Indiana Gas & Electric Co. for the duration of the war plus six months. Evansville will pay $61,350 annually for 2,265 street and park lights.

Post-War Personnel Guide Offers Problem Solutions

"Personnel Problems of the Post-war Transition Period," is the title of a guide to the solution of these problems written by Charles A. Myers for the Committee for Economic Development and now being distributed by that organization. The author is associated with the Industrial Relations Sections, Massachusetts Institute of Technology.

The booklet contains a check-list of questions which personnel managers and other management officials may use in formulating post-war personnel policies. The questions are grouped in four sections, Rehiring of Servicemen, Personnel Transfers within the Plant or Company, Laying off Workers, and Hiring New Workers. Answers are based on the experiences of 32 manufacturing and non-manufacturing companies.

A third part of the booklet is entitled "Analyzing the Present Work Force and Estimating Post-war Labor Supply and Requirements."

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Cleveland Raise Denied

National War Labor Board has upheld its Fifth Regional Board in refusing to grant a seven-cents an hour raise to employees of the Cleveland Electric Illuminating Co. The National Board found that the employees had received increases above the "Little Steel" formula and were not receiving substandard wages; therefore were not entitled to an increase. The appeal was made by the local C.I.O. union.

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Utility Coal Consumption

Electric utility power plants consumed 7,120,331 tons of coal in November, 1944, the Federal Power Commission has reported.

UTILITY REPORTS

	Net Income 1944	1943
*American Gas & Electric and subs.	$12,048,369	$12,023,503
*Arkansas Power & Light	2,079,344	1,548,240
‡Birmingham Electric	1,443,723	1,441,145
*California Electric Power and subs.	1,289,985	1,142,721
*Carolina Power & Light	2,342,663	2,534,910
*Engineers Public Service and subs.	6,781,188	5,444,852
*Louisiana Power & Light	842,244	1,122,744
*Mississippi Power & Light	1,389,297	709,411
*New Orleans Public Service	1,744,655	1,872,860
*Northwestern Electric	542,729	644,975
*Pennsylvania Power & Light	5,521,879	5,881,351
*Puget Sound Power & Light and subs.	5,137,429	5,299,862

*Twelve months ended November 30.
‡Twelve months ended October 31.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Removable Bracket for Lightning Surge Links

By M. M. DEVORRIS

Transmission and Distribution Department, Pennsylvania Edison Co., Altoona, Pa.

With the construction of an important 45-kv. (115-kv. design) transmission line, it was deemed desirable to provide a practicable means of determining the location and magnitude of lightning strokes to the two overhead ground wires protecting this circuit.

Consideration was given to the use of the so-called "magnetic links," which, when magnetized by the lightning current in the ground wire down leads, could then be calibrated to determine the magnitude of the lightning stroke.

Since the magnetic links would have to be mounted on wood poles out of reach of the public, it was desirable that the links be accessible to patrolmen from the ground, so that climbing the poles would not be necessary. All available commercial brackets were of the type which are permanently fastened to the pole, and were, therefore, not suitable for the desired use.

The bracket shown in the accompanying drawing was designed to meet our requirements for an inexpensive device for mounting the magnetic links in such a manner that a patrolman using a 5-ft. clamp-type switch stick, could readily remove the brackets in order to check each link with a small "scout compass" to determine if the link had been magnetized.

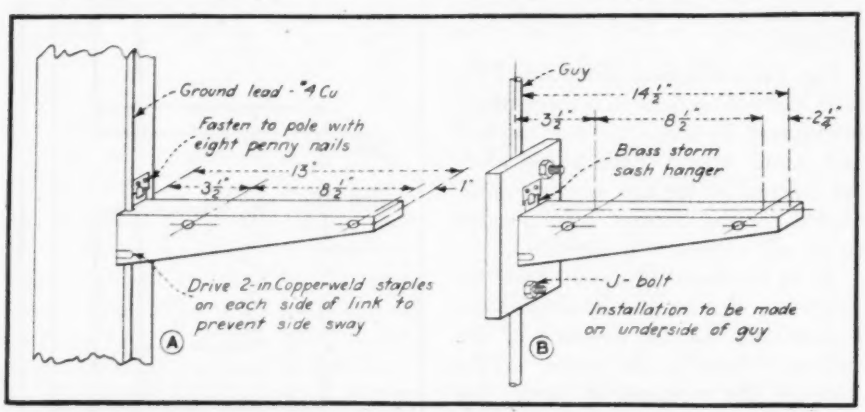
The inner link is 3½ in. and the outer one 12 in. from the ground wire or guy wire.

Discharge currents of the following magnitudes were recorded during the lightning season of 1944: 5,800; 7,300; 12,000; 4,000; 20,000 and 9,000 amperes.

Each recorded lightning stroke to the overhead ground wires apparently discharged through the down leads of only two structures. The average span length for this circuit is 600 ft.

The cost of these brackets, complete with hanger, was fifty cents per bracket.

A small printed envelope is used by the patrolmen for recording the necessary information regarding any link which is found magnetized. It records circuit designation, pole number, whether inner or outer link, date and time and location of link (pole or guy). Each link is first encased in a magnetic shield and then put in a separate envelope. The usual surge crest ammeter is used by the engineering department for calibrating the links. After being calibrated the links are demagnetized and returned to the various patrolmen for future use.



TAPERED WOODEN BRACKET (cut from 2 by 4-in. fir) hung from pole or guy wire by Stanley brass storm-sash hanger supports two magnetic links at 8-ft. height above ground accessible to patrolman using clamp-type switch stick

A. Pole-mounting; B. Guy mounting with hanger attached to 7½ by 3½ by ¾-inch wooden block. Two brackets cut from standard width of 2 by 4-in. lumber

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Safety in Cleaning Organic Solvent Tanks

Cleaning or repair of tanks in which organic solvents are used should not be undertaken without rigid precautions, inasmuch as the vapors of all organic solvents are toxic and the majority are flammable as well. Oxygen deficiency in the tank is another hazard which must be considered, according to Safety Research Institute, New York.

If a tank has contained a flammable solvent, the safest method for removing the vapors, preparatory to cleaning or repair, appears to be thorough flushing by steam, followed by mechanical ventilation of a type approved for flammable vapors. Steam jets to loosen sludge have been successful. the tank then being washed, drained and dried out with warm air. If the use of steam is impractical, the sludge may be washed out with high-

pressure hose but care must be exercised to avoid building up static electricity. Steam also has some disadvantages, such as the building up of combustible mixtures at the vents. Nonsparking shoes and tools, vapor-proof lamps, and protective clothing should be utilized, and otherwise the Code for Flammable Liquids and Gases of the National Fire Protection Association should be observed.

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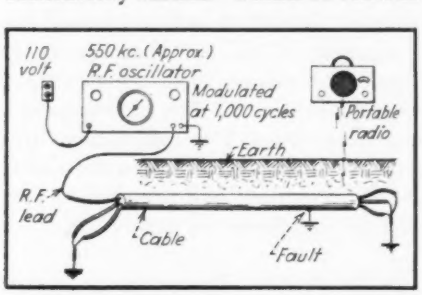
R. F. Oscillator Aids Locating Cable Faults

By G. L. DANNER
Chief Electrician, A.S.F. Ordnance Department Jefferson Proving Ground, Madison, Indiana

A method employing tone modulated radio frequency for the location of faults in underground cable has been in use at the Army Services Forces, Ordnance Department, Jefferson Proving Ground, Madison, Indiana. It differs from other methods frequently used and has given very satisfactory results. Faults of various



TONE MODULATED radio frequency used to locate faults in underground cable. A loud signal via radio receiver is usually heard directly over fault

kinds, such as dead shorts, high resistance shorts, opens, dead grounds and high resistance grounds, have been located by this method.

The system was first used in 1941 on a 2,400-volt parkway cable, slightly over a mile long, that had developed an open circuit. Infinity tests were obtained when an insulation tester was used. When an attempt was made to measure the capacity of the cable it was seen that the results could not give an accurate location of the fault. It was then that a radio frequency oscillator was obtained from the Radio Repair Section and connected to the "open" wire at one end of the cable. All other wires at both ends were grounded. The oscillator was adjusted to approximately 550 kilocycles and this signal was modulated by a 1,000-cycle built-in audio oscillator. A standard portable broadcast receiver was tuned to the oscillator's frequency by completely closing the tuning condenser. A strong signal could then be heard in the receiver.

By referring to the capacity measurements previously made the approximate location of the fault was determined. The exact location of the cable was found by walking diagonally across it. Once the cable was crossed a signal could be heard in the receiver. Then by walking along the length of the cable a very strong signal could be heard when directly over the fault. Excavation and repair of the cable was then a simple matter. It is usually good practice to change the frequency of the r.f. oscillator and check results again, as nodes and freak effects may be noted occasionally.

Advantages of this system are:

1. No special, complicated or expensive equipment is required. A modulated oscillator can be borrowed or rented from almost any radio repair shop. The receiver is a standard battery operated broadcast radio.
2. It is not necessary to reduce the fault to low resistance.
3. Opens as well as grounds and shorts (high and low resistance) can be located.
4. No mathematical calculations are necessary.

In addition a 50,000-ohm fault in a control cable, a dead short caused by lightning in a 2,400-volt power cable, and a wet splice in a two-conductor No. 10, 2,400-volt cable have been located by this method.

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Test Electrodynamic Power Factor Meters

By PAUL MacGAHAN
Meter Division, Westinghouse Electric & Manufacturing Co., Newark, N. J.

A simple method, based upon the principle of the instrument's operation, has been developed for calibrating and testing three-phase electrodynamic power factor meters. It will be recalled that the various makes of power-factor meters in present general use are essentially "phase-angle meters" and only read "power factor" of polyphase circuits under balanced load, sine wave conditions. They are calibrated and the scales are marked to read the cosines of the angles of lag or lead between a single-phase current, and one of the polyphase line voltages.

Fig. 1 is a schematic diagram of the coils and connections of a three-phase instrument. In action, the moving coil and pointer system comes to rest when the torques of the two moving coils, caused by the current coil, become equal and opposite in direction.

As in the usual electrodynamic instruments, the torques developed are proportional to the product of the current values in the coils, to the sines of the mechanical angles between the stationary and movable coils, and also to the cosines of the electrical angles between the current and the voltage. The mechanical angles between the stationary and movable coils vary with the scale deflection.

On this basis the power factor's effect upon the instrument can be simulated by applying variable percentages of the normal line voltage to the two moving coils, in the meantime applying the normal rated current to the stationary coil. The applied current and voltages should be in phase, and connected as shown in

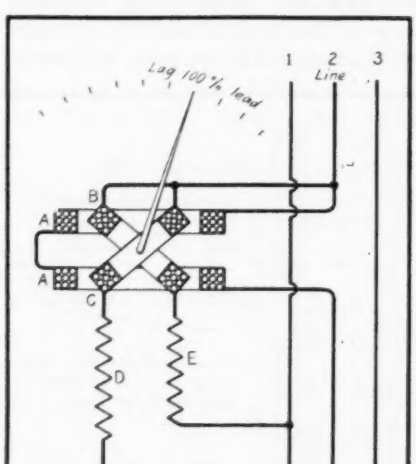

FIG. 1—Coil and line connections of a three-phase power factor meter

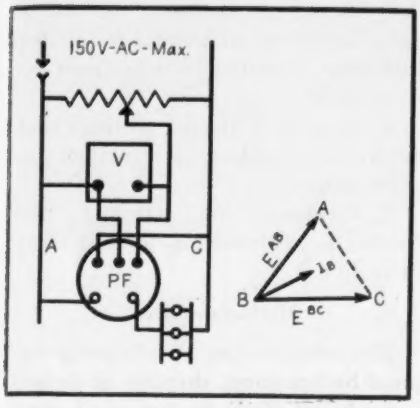

FIG. 2—Connections for a three-phase, 100-deg. scale power factor meter calibrated by variable voltage method

the diagram Fig. 2. Thus from the above brief explanation the applied voltages as given in the accompanying table may be used for calibrating the main scale points of a power factor meter. The voltage settings for other scale points may be readily calculated from the above indicated torque law of the instrument.

It will be noted that only a voltmeter together with either a slide-wire potentiometer-type resistor of about 1,000 ohms resistance and a lamp-load are required for calibrating power factor meters. The value of current used for the current coil is unimportant so long as it is kept within from half to full load rating of the tested instrument.

Instead of the slide wire resistance, a Variac with a calibrated scale may also be used. Where many power factor meters have to be continuously calibrated, an autotransformer with taps corresponding to the various voltages may be provided, with a dial switch marked in power factor. With accurate scale markings on a Variac or on a multi-tap transformer, the voltmeter may be used across the supply line to merely monitor and adjust the line voltage to a constant value, such as for example 100 volts, and the calibration points may be taken by reference to Variac or transformer tap markings.

Voltages for Calibrating a Power Factor Meter

Power Factor Scale	Voltage Settings, Percent of Normal Volts Coil AB	Coil BC
100	100.0	100
90 lag	56.2	100
80 lag	39.6	100
60 lag	13.1	100
50 lag	0	100
30 lag	−28.9	100
20 lag	−47.3	100
90 lead	100.0	56.2
80 lead	100.0	39.6
60 lead	100.0	13.1
50 lead	100.0	0

The method described is not applicable to power factor meters which operate on the moving-iron principle.

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How to Protect Metering Equipment

I—High voltage Metering Station*

By R. F. QUINN
Central Station Engineering Division
General Electric Co., Schenectady, N. Y.

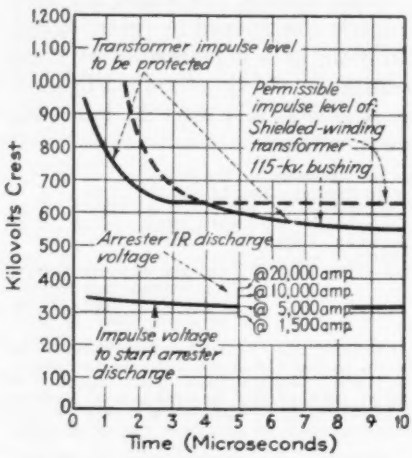
Meter engineers are aware of the effects of lightning on meters and metering equipment, but often times do not give enough attention to proper lightning protection. Possibly this is due to the fact that quite a bit of metering equipment is located where it is inherently protected by lightning arresters installed primarily for the protection of other apparatus. As an example, if there is a large substation which has been designed to have adequate station lightning protection, the meter engineers will install metering equipment in this station without considering lightning protection.

In this series of articles it is proposed to cite metering installation conditions which may require protection against lightning impulses and to show what protection should be applied. Adequate metering protection starts with proper protection of the system in which the metering is installed.

Station Protection

Good station protection requires that appropriate lightning arresters be connected to all incoming and outgoing circuits on the line side of the first piece of apparatus and as close as practical to its terminals. The arresters are connected to a low resistance ground which should also be tied to the common ground, to which are connected the tanks of power transformers, instrument transformers, and circuit breakers. In addition, an overhead ground wire should be installed to shield the station and each overhead line for a distance of approximately 2,500 ft. This overhead ground wire prevents direct strokes from terminating on station apparatus or line conductors in the vicinity of the station. Strokes to the line beyond that zone of shielding must reach the station apparatus through part of the surge impedance of the line, which results in controlled severity of wave fronts as well as stroke currents and permits positive coordination of protection within the station. These lightning arresters, together with the overhead ground wires thus limit the magnitude of incoming waves at the station to a value below the demonstrated impulse strength of the station equipment.

However, there is still an important consideration to be taken care of. All current transformers, being connected in series with the line, present an inductance to the passage of a lightning wave through the winding which causes an impulse voltage to be built up across the series winding. As previously stated, arresters reduce the amplitude of the incoming wave to protect against flashovers and insulation failure to ground. However, this reduced wave, which the insulation to ground is designed to withstand without harm, can still be of such magnitude and steepness of wave front as to cause high stresses between turns in a current transformer.



MARGIN OF PROTECTION afforded to the apparatus insulation by a modern station type arrester. Shows the impulse coordination of a 115-kv. transformer winding and bushing and 115-kv. station type lightning arrester

For this reason, a bypass protector having a non-linear resistance characteristic should be connected across the current transformer so that it directly shunts the series winding. With the current transformer shunted by such a protector, when an impulse wave reaches the series winding and

* First of a series of five articles.

the voltage starts to build up across this winding, the resistance of the protector decreases due to the inherent characteristics of the arrester material and thus bypasses most of the impulse current around the current transformer. When the lightning wave has passed, the resistance of the bypass circuit increases and under normal conditions it passes a very small leakage current, (less than 1/20 of one percent of line current) which has a negligible effect on the accuracy of metering from the current transformer.

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Oils and Lubrication of Steam Turbines—IX*

Limiting Characteristics

By A. F. BREWER
Technical and Research Division
The Texas Co., New York City

Steam turbine oils which are kept properly conditioned by centrifuging, filtration, or a combination of these treatments, can be continued in service as long as they meet the following specifications:

Water, percent	0.1 Max.
Neutralization No.	1.5 Max.*
Precipitation No.	0.01 Max. (dry)
Ash, percent	0.01 Max.
Corrosion, Copper Strip	Negative
Viscosity	As per manufacturer's recommendation for the particular unit or as normally used in unit.

* Where the Neutralization Number is known to have risen abruptly in the previous three months this limit should be halved. Where the Neutralization Number is known to have risen slowly over two or more years service this limit may be doubled.

Where reconditioned or used turbine oils are to be placed in turbine service as a fresh fill to the system, the discharge should be watched closely for a short time thereafter to see that the oil is clean.

The above limits are maximum with respect to each item, and they should seldom or ever be approached if the turbine system is properly maintained.

Lubrication of turbine bearings was involved in some of the earliest research engaged in by the petroleum industry. From the beginning, turbine bearings have been of the conventional sleeve type, commonly known as plain bearings. Consequently the theory of lubrication as developed during this period of research was applicable to turbine bearings, and of material assistance when bearing dimensions, rate of oil flow and oil viscosity had to be figured based upon expected loads, speeds and temperatures.

* Concluding article in a series which began in the ELECTRICAL WORLD, September 30, 1944, page 93.

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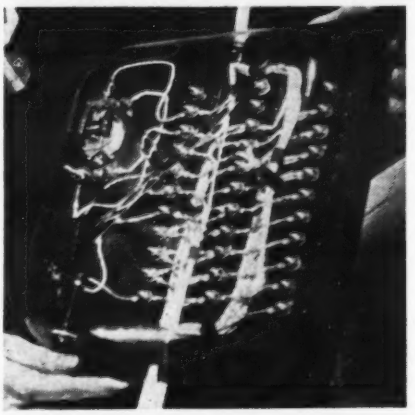
Junction Box Saves Time and Tempers

Plastic electric junction box, which will save the field service man's time and temper since it has a sensitized base plate and reproduces thereon by photographic process the wiring diagram of that box is now being used by the services. It also reverses present practice by using a flat plate as the main section to which wires are attached and a molded transparent plastic for segregating the terminals.

Junction box was developed by Harry Cramer, Engineer of Glenn L. Martin Co., Baltimore, Md., for aircraft application, but is applicable to other types of junction boxes, since it not only assists the field man but simplifies drilling and assembly at the factory.



SENSITIZED flat base plus transparent cover saves field man's aggravation

•

Method of Applying Pentachlorphenol

By E. A. STANGER
Distribution Manager
Southern Canada Power Co.
Montreal, Canada

Pentachlorphenol solution is used by Southern Canada Power Co. to treat any wood which it is desired to protect against decay or to arrest decay. It will also protect the wood against the attacks of termites and similar insects.

Routine uses are:

1. Treatment of standing untreated poles.
2. Treatment of timber structures.
3. Treatment of poles and timbers that may be stored in pole yards for some time.
4. Treatment of mill sections such as wood moulding and planks for cable protection.
5. Treatment of standing butt treated poles from top to butt treatment line.

Methods of Use

The solution can be efficiently applied by spraying, dipping or brushing. In all methods, the wood must be dry as the carrier is oil and if the wood is filled with water or sap the oil cannot be absorbed by the wood. For this reason the following specific methods of use are recommended.

1. *Standing poles.* Butt treating season May 15th to October 30th. Dig a trench around the pole so that 18 in. of pole below normal ground line is exposed. Leave trench open for at least 24 hours for the surface of the pole to dry out. Do not make any special effort to remove decayed wood as this forms a reservoir for the preservative. When pole is thoroughly dry spray the pole from 18 in. above ground line to bottom of trench liberally, using ½ gallon per pole. Backfill and tamp. Any checks or cavities should be given special attention. Poles should not be treated until they are 4 or 5 years old.

2. *Timber structures.* These may be treated at any time of year provided the wood is dry for at least a depth of ½ inch. The solution may be applied by spraying or brushing, whichever method is most convenient. Native woods take up the solution readily, but B. C. fir does not readily absorb the solution and best field results will be obtained on these timbers on very hot summer days when the wood is noticeably warm.

3. *Poles and timbers* that are to be stored on racks or in piles for stock and emergency use should be given a light, full-length spray coat as they are piled. This is only intended as a precautionary measure for the storage period as in general the wood will be too green for full preservative treatment.

4. *Treatment of small mill sections* such as wood moulding, crossarms, etc., should be made by dipping.

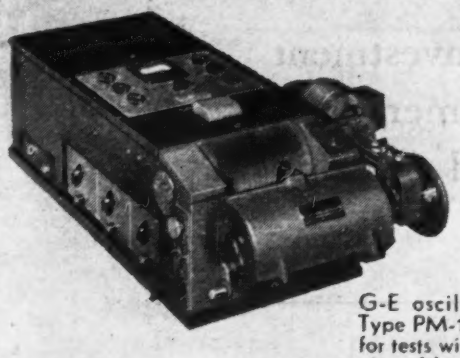
For wood moulding and similar sec-

Announcing

A MINIATURE OSCILLOGRAPH

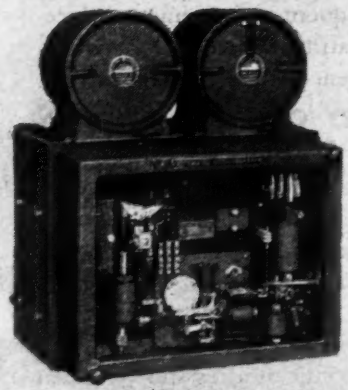
WEIGHS 10 POUNDS

SIZE: 4½ by 4½ by 14 inches



G-E oscillograph, Type PM-10, set up for tests with magazine film holder, driving head, and a-c motor unit

Portable oscillograph, Type PM-12, for general use where only two elements are required



Automatic oscillograph, Type PM-13. Starts recording one-quarter cycle after disturbance occurs

THIS 6-ELEMENT OSCILLOGRAPH was developed for use where light weight and small size are essential. It's easily portable, to obtain "on the spot" photographic records of the characteristics or the performance of many machines and devices. Records simultaneous variations of six rapidly changing phenomena. Type PM-17; net price, $850 up. Write today for leaflet GEA-4331.

IF SMALL SIZE IS NOT ESSENTIAL, HERE ARE OTHER G-E OSCILLOGRAPHS

TYPE PM-10—Records 6 to 12 phenomena simultaneously. A large, multi-element, general-purpose oscillograph for a wide field of application. Includes simultaneous viewing with recording. Net price, $3160 up.

TYPE PM-12—Anyone can operate it. For work in the field, in the laboratory, or in the classroom. For either visual indications or taking oscillograms of current and voltage waves. Originally developed for school use, industry has found this 2-element portable especially valuable for observing or recording welding current. Net price, $665.

TYPE PM-13—Entirely automatic. Can take as many as 100 oscillograms of transients and surges without attention. Particularly useful for determining the sequence of relay and breaker operation and the effect on system stability. Net price, $2125.

Our nearest office will be glad to help you select the right oscillograph for your specific requirements. *General Electric Company, Schenectady 5, N. Y.*

BUY WAR BONDS AND KEEP THEM

GENERAL ELECTRIC

Repetitive-Manufacture

A discussion of advantages from

You can reduce your investment costs by specifying transformers with RM-listed kva ratings and utilizing their "loadability."

THE custom of specifying a transformer kva rating to match an "exactly" calculated load arose from a natural desire for economy. But as a result, transformers have been built in almost every intermediate step from 667 through 10,000 kva, requiring special treatment in design and manufacture that added to the cost.

How often was the "exact" kva rating needed really known or even accurately calculable? The general manager of an Iowa power company writes:

"In looking over our experience during the past years, I can readily see where, in practically all cases, we could have adapted our requirements to enable us to use a standardized product."

By ordering from a range of carefully selected, *listed* ratings, you gain all the benefits that can be realized through repetitive manufacture, such as lower prices, quicker shipment, simplified purchasing, and an improved product.

The kva ratings selected for General Electric RM-listed power transformers conform to those listed as "preferred" by ASA for step-down service: sizes chosen as the result of many years' operating experience in the range 667 to 5000 kva, single-phase; 750 to 10,000 kva, three-phase—2400 to 66,000 volts.

These ratings permit a practical and economical choice for most applications, and are often the logical choice because:

1. KVA LOADING AND LOAD GROWTH CAN ONLY BE ESTIMATED.

Actual kva loadings on substation transformers, for either power-company or industrial applications, depend on many variables, including diversity. These variables make it extremely difficult to figure the load very accurately. Also, it is usually desirable when selecting a kva rating to provide for several years' load growth in order to avoid too frequent transformer replacement. An RM-listed rating which will provide a suitable margin can generally be selected.

2. HIGH SECONDARY CURRENTS RESULT IN UNECONOMICAL DISTRIBUTION.

Study may show that choice of a higher voltage, or division of the total transformer capacity into two or more smaller RM-listed units, will make it possible *to save on over-all system costs, conserve copper, reduce circuit-breaker interrupting duty, and provide better voltage conditions.*

EXAMPLE A: Economic studies show that, at 480 volts, a typical distribution system which utilizes three-phase RM-listed power transformers rated 750 kva will be 25 per cent less costly than a comparable system in which the

Power Transformers

*the standpoint of KVA RATING**

required transformer capacity is installed in units rated 3000 kva or larger.

EXAMPLE B: Similar studies have revealed savings of as much as 50 per cent in system costs, when RM-listed power transformers were used with 480 volts as the secondary distribution voltage, instead of 240 volts.

3. TRANSFORMER "LOADABILITY" SHOULD BE CONSIDERED.

The ASA recognizes that, under many conditions of operation, transformers can carry, for short periods, loads which exceed the nameplate kva rating. Thus, a 5000-kva self-cooled transformer, initially carrying no load, can carry an emergency overload of 7500 kva for two hours.

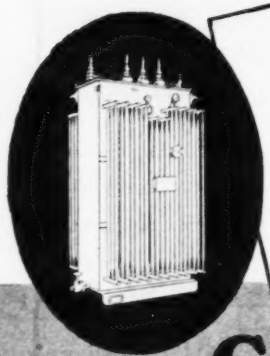
The AIEE indicates somewhat larger emergency loadings, with only moderate sacrifice in transformer life expectancy. Thus, the same 5000-kva transformer, initially carrying full load, on this basis could carry an emergency overload of 8500 kva for two hours.

Such transformer "loadability" should be carefully considered before kva ratings other than RM-listed ratings are specified. If short-duration peak loads are the main reason for the "special" rating, study of the loadability curves of standard units may show that an RM-listed rating slightly lower than that of the "special" will be suitable for the job, and that a considerable saving in cost can be made.

4. FORCED-AIR COOLING GIVES FLEXIBILITY TO NAMEPLATE RATING.

The forced-air-cooled kva rating of RM-listed transformers is either 25 or 33⅓ per cent more than the self-cooled rating, depending upon size; yet winding temperatures (average and hotspot) are within ASA limits. Forced-air cooling affords an attractive means for handling repeated or frequent peak loads or seasonal overloads, even though the higher losses and greater voltage drop that occur at the increased rating may tend to make its use undesirable for continuous forced-cooled operation. Properly applied, forced-air cooling can save unnecessary investment.

*This is the first in a series of messages designed to help you select and apply RM-listed power transformers — to help you gain the maximum benefit from them. Ask for Booklet GEA-4283 for complete descriptive information on RM-listed G-E power transformers, and Booklet GEA-4338 for additional data on how to select and apply these transformers. *General Electric Company, Schenectady 5, N. Y.*



RM-listed power transformers and unit substations are the result of repetitive manufacture of standard designs. Many of the parts used are manufactured in large quantities and carried in stock. The benefits to you: Quicker shipment (about 33 per cent less time), lower cost (6 per cent less), and simplified purchasing.

Buy all the BONDS you can—
and keep all you buy

GENERAL ELECTRIC

491-21-5155

ions a small horizontal tank of ength and section sufficient for six ieces at one loading should be used. 'his should have a rack at one end 'here the treated sections can stand ertically so that they may drain and ie excess solution run back into the ink. For woods other than B. C. r an immersion of 3 minutes is suffiient. The treated material should be llowed to dry 72 hours before use.

B. C. fir crossarms should be treated ı a vertical tank. The depth should e at least 75 percent of the longest rm to be treated and the section ased on the number of arms to be eated at one time. After all necesary holes have been bored in the rms they should be soaked for 24 ours then turned end for end and oaked for a further 24 hours, rained, and dried for at least 72 ours before use. Planks which are) be buried in the ground as troughs, r cable protection, should be given liberal brush coat and allowed to ry for 72 hours. The troughs are ıen laid, and given a second coat by praying before back filing.

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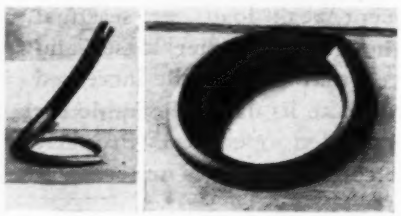
'lastic Grommets

Grommets made from a piece of 'lamenol or other plastic wire insuation are used extensively by Pacific as & Electric Co. as a result of suggestion by G. P. Davidson of ie general construction department.



GROMMETS made of plastic insulation from scrap wire prove excellent substitute for metal and rubber bushings

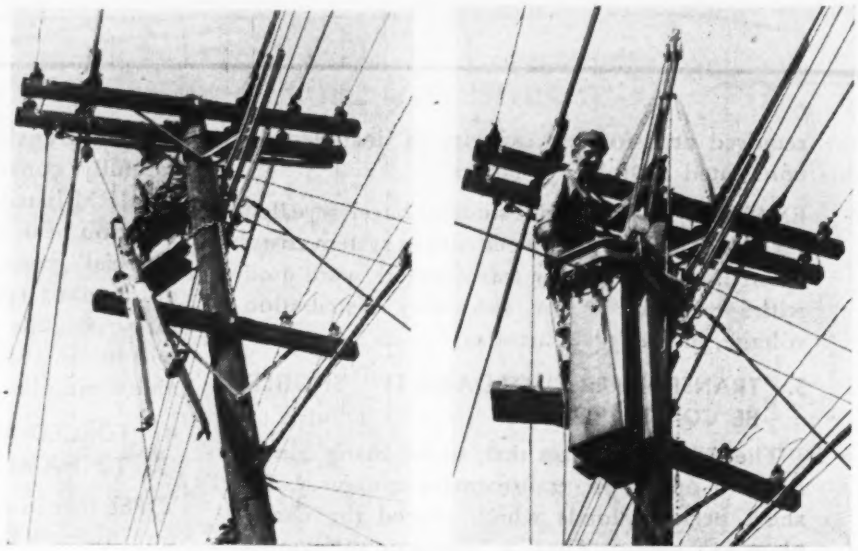
loles and knockouts are bushed in urtiStrip and other raceways, cans, tc., for switchboard wiring, control ircuits, meter leads and similar wirıg. The insulation on a piece of scrap ire is slit lengthwise of the wire, eeled off and cut to length to fit withı the perimeter of the bushed hole.

Various thicknesses of metal can e accommodated by choosing inılation from the proper size of wire. he idea has especial merit under resent wartime shortages of metal nd rubber bushings.

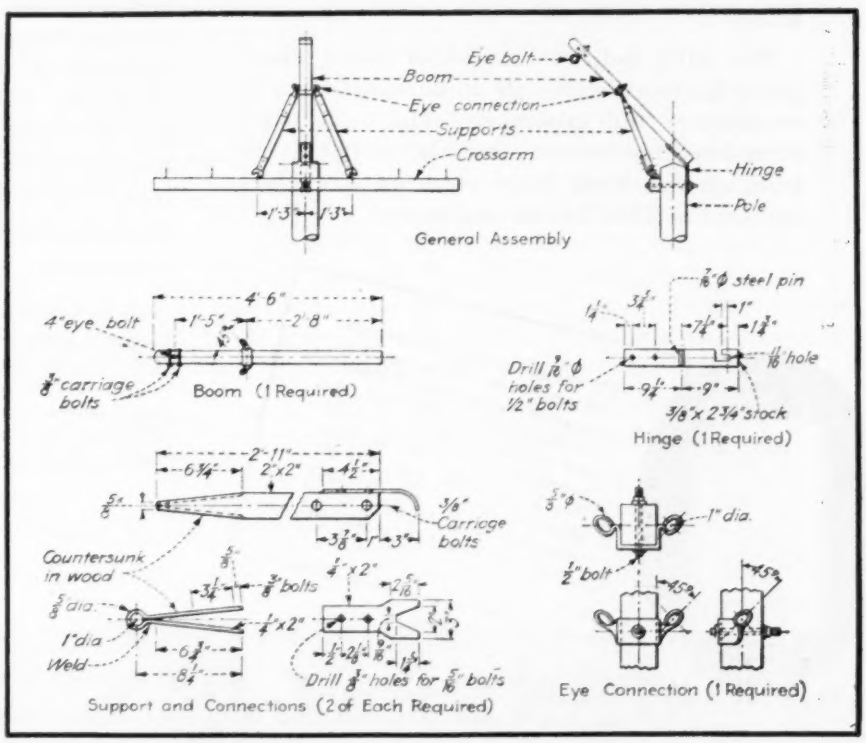
Gin for Lifting Transformers

A gin is shown in the accompanying illustrations which facilitates handling distribution type transformers up to and including 25-kva. rating in pole work. The device was designed by M. G. Williams, superintendent of distribution of the Worcester Suburban Electric Co., Marlboro, Mass., a New England Power System utility. It is composed of non-conducting material, is readily portable and easy to use. Essentially it consists of a boom and supports of seasoned hickory, with a minimum number of metal parts. It can readily be made by a blacksmith, or of oak or ash if desired, though hickory is preferred.

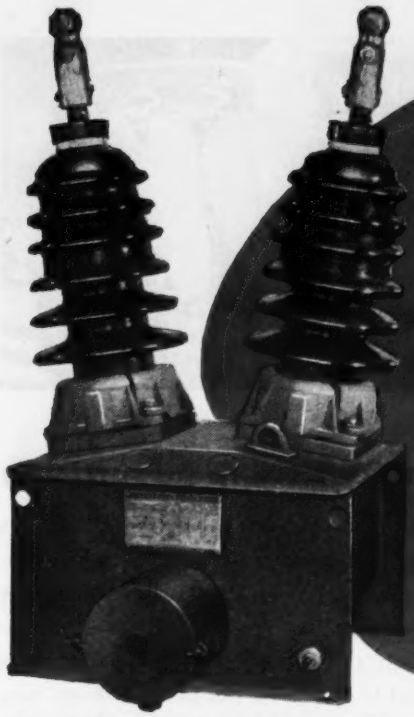
The gin is adapted particularly to pole construction that consists of a crossarm for primaries and a secondary rack for low voltage supply. Its supports provide for hinged attachment to a connection near the pole top, with bracing against pins as shown. No second crossarm is required for supporting the gin.



GIN (left) HOISTED TO CROSSARM LEVEL by block and tackle. Gin in place (right) on pole structure, with 25-kva. transformer lifted into position for mounting on pole.



DIMENSIONS OF PIECES required for making transformer gin



Type E-236 potential transformer, 24,000 volts, for accurate metering service and relay operation

Why IS THE ACCURACY CLASSIFICATION OF THIS INSTRUMENT TRANSFORMER IMPORTANT TO YOU?

Here's the Accuracy:

ASA Burden	W	X	Y	Z
ASA Accuracy Class	0.3	0.3	0.3	0.3

This means that with standard ASA burdens the ratio correction factor and the transformer correction factor will be within the limits of the ASA accuracy class 0.3.

NEMA Burden	W	X	Y	Z
NEMA Accuracy Class	¼	¼	¼	¼

This means that with standard NEMA burdens the ratio error and the phase angle will be within the limits of the NEMA ¼ accuracy class.

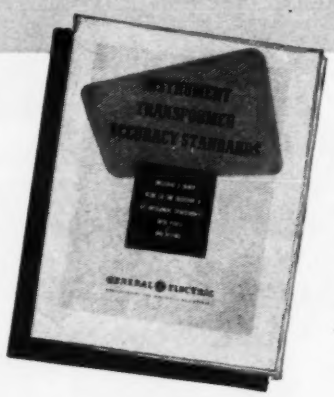
Accuracy Classification Helps You KNOW It's the Right Transformer for the Job

THE new ASA system of accuracy classification has made possible the most precise method yet devised for selecting instrument transformers. It enables you to select the most suitable transformer for the job to be done.

For example, different applications often require different transformer characteristics. A current transformer that is satisfactory for metering purposes (highest accuracy up to 100 per cent of its current rating) may not be satisfactory for relaying purposes where the *overcurrent* characteristics (currents as high as 20 times normal) must be considered.

All G-E instrument transformers are classified in accordance with the new ASA system of accuracy classification. A thorough knowledge of this system will help you in the selection of transformers for your particular application. *General Electric Company, Schenectady 5, N. Y.*

Buy Bonds — *and keep all you buy*



HEADQUARTERS FOR ELECTRICAL MEASUREMENT

FOR A BETTER UNDERSTANDING OF ACCURACY CLASSIFICATION

This publication explains the ASA accuracy standards for current and potential transformers and shows how they differ from the NEMA standards. Also, you will find this booklet a handy guide to the selection of G-E instrument transformers. Ask for Bulletin GEA-4240. Address the nearest G-E office.

GENERAL ELECTRIC

604-14-6400

1. With G-E Lamp Advertising

G-E Lamp Department advertising today is reaching just about *all* your postwar commercial lighting markets. These G-E ads are appearing not only in general magazines such as Time, Newsweek, Business Week and U. S. News, but also in *thirty-nine* other publications that reach special business fields—from banks to beauty parlors.

They are building up among your commercial customers the desire for higher standards of lighting.

And G-E offers you a plan for taking advantage of this growing demand NOW. It's the G-E "Nest Egg" Plan. Read how it works.

G-E MAZDA LAMPS

for Better Postwar Commercial Lighting!

2. With G-E's "NEST EGG" Plan

More than 60 per cent of the merchants interviewed in a recent General Electric survey said they had been influenced to buy fluorescent lighting by *installations in other stores.*

That fact is the basis of the "nest egg" plan. By selling one outstanding relighting job in each shopping area NOW you set the postwar standard for the whole neighborhood.

Store owners want your help—more than two-thirds say they look to utilities for advice. Here's what you do!

FIRST: **Select your nest eggs.** Find a good prospect for modernized lighting in each neighborhood in your territory, and show him how he can become the leading merchant in his neighborhood by relighting *first.*

SECOND: **Order the materials NOW.** Bring a contractor and supplier in on the job . . . make a layout for the store's general lighting, and showcase, display and decorative lighting, both incandescent and fluorescent. Place orders for the fixtures, lamps and all other materials NOW, for delivery as soon as available.

THIRD: **Get the nest eggs installed first.** With all this pre liminary work done, you can see to it that these stores ar among the first in their neighborhoods to be relighted . . shining examples of good lighting . . . "nest eggs" tha will make other stores in the same neighborhoods wan good lighting jobs.

WHY NOT CONSIDER THE G-E "NEST EGG" PLAN FOR YOUR TERRITORY?

Hear the G-E radio programs: "The G-E All-Girl Orchestra", Sunday 10 p.m. EWT, NBC; "The World Today" news, Monday through Friday 6:45 p.m. EWT, CBS: "The G-E Houseparty," Monday through Friday 4:00 p. m. EWT, CBS.

GENERAL ELECTRIC

SIMILAR RACKS FOR CAPACITORS AND OPEN-DELTA TRANSFORMERS

By FRANK E. SANFORD, Distribution Engineer, Cincinnati Gas & Electric Co.

The direct-bolting arrangement of the EEI-NEMA transformer is followed in our method of mounting a 3-phase capacitor installation and also for mounting two 15-kva. transformers in open delta. In both cases hangers are dispensed with; it is our practice in nearly every instance to use 3-phase transformers where two in open delta do not suffice. The drop conductor for each phase line is No. 6 safety cable and for the neutral is No. 6 T.B.W.P. Distance between lowest rack bolt and lightning arrester crossarm bolt is 6-in. minimum. Ground wire moulding is indicated by dotted line to base of pole in Fig. 1; moulding is used similarly in Fig. 2.

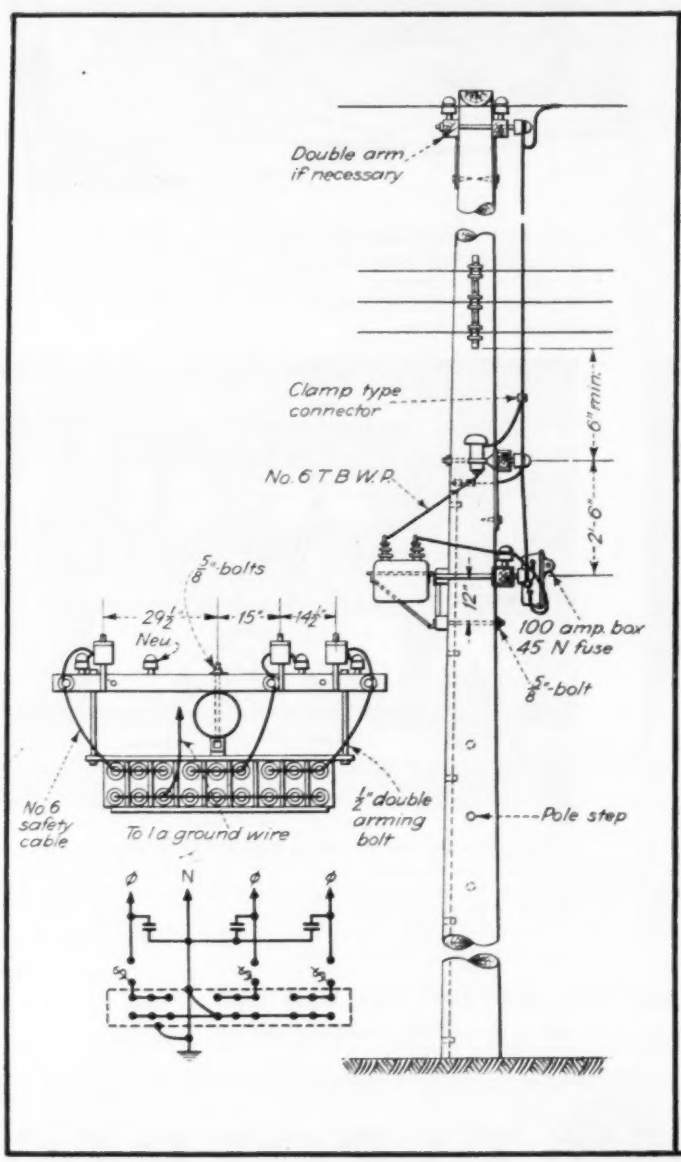


FIG. 1—Rack arrangement for 3-phase capacitor bank

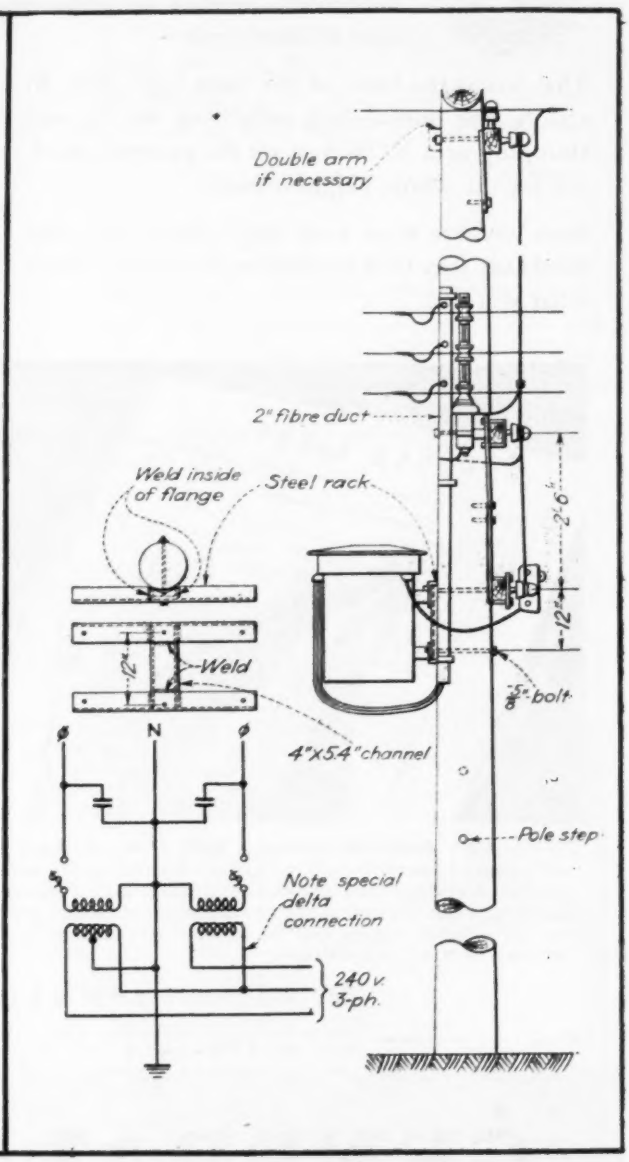


FIG. 2—Similar rack for open-delta transformer installation

Specially-Prepared Switch Copper by REVERE

Revere has developed a new method of manufacturing Switch Copper to meet the exacting requirements of the electrical industry on an economical basis.

The process produces Switch Copper with a surface finish far superior to regular commercial bar copper, and with exceedingly close tolerances. Flatness measured across the width of the bar is kept to the following Revere standards: — Convexity none. Concavity, .001″ maximum per side up to 2″ wide, .002″ per side, 2″ and over. Camber, or depth of lengthwise arc 1/8″ maximum in 8 feet. Edges are full rounded unless otherwise specified. Made from electrolytic copper, meeting the A.S.T.M. specifications for purity and conductivity.

This is really beautiful metal. Its superior finish and flatness mean that simple cutting and drilling are enough to produce switch blades that will make perfect contact, reducing current losses. Naturally, Revere Specially-Prepared Switch Copper carries a slight premium in price, but those who have used it report this is insignificant compared with the large savings made possible by abandoning the expensive finishing processes required when using ordinary commercial bar. Revere Switch Copper is also being used in: knife-blade fuses; switchboards; in other equipment requiring exposed bus bars. For further information, write Revere Executive Offices.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

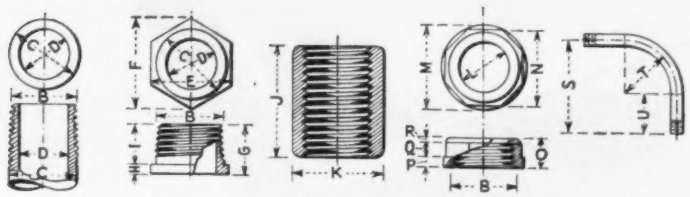
Executive Offices: 230 Park Ave., New York 17, N. Y.

CONDUIT AND FITTINGS DIMENSIONS AND SPACINGS

By M. V. EARDLEY, Engineer Power System, Department of Water and Power, City of Los Angeles

For thirteen nominal sizes of rigid conduit, from ½-in. to 6-in. diameter, tabulations list dimensions of the pipe, bushings, couplings, elbows and nipples; also spacing of aligned conduits when the clearance is ¼ in. between locknuts. Both tables are adaptations from electrical standards of the Power System, Department of Water and Power, City of Los Angeles, California.

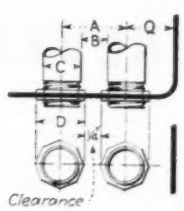
DIMENSIONS OF CONDUIT AND FITTINGS



Conduit. Nipples. Couplings. Bushings. Elbows.

Conduit Size, in.	Weight per ft., lb.	Threads: No. per in. A	Threads: Dia., in. B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	Conduit Size, in.
½	0.85	14	0.82	0.84	0.62	0.97	1.12	0.62	0.12	0.50	1.37	1.12	0.62	1.00	0.94	0.37	0.12	0.19	0.06	6.75	3.75	3	½
¾	1.12	14	1.02	1.05	0.82	1.19	1.37	0.82	0.19	0.62	1.56	1.31	0.75	1.25	1.12	0.44	0.12	0.25	0.06	6.75	3.75	3	¾
1	1.67	11.5	1.28	1.31	1.05	1.37	1.59	0.94	0.25	0.69	1.75	1.62	1.00	1.50	1.37	0.50	0.16	0.25	0.09	9	5	4	1
1¼	2.24	11.5	1.63	1.66	1.38	1.75	2.02	1.06	0.25	0.81	2.12	2.00	1.25	1.81	1.75	0.56	0.19	0.28	0.09	9.50	5.50	4	1¼
1½	2.68	11.5	1.87	1.90	1.61	2.00	2.31	1.12	0.31	0.81	2.50	2.25	1.50	2.12	2.00	0.56	0.19	0.28	0.09	10	6	4	1½
2	3.61	11.5	2.34	2.37	2.07	2.50	2.89	1.31	0.31	1.00	2.62	2.75	1.94	2.56	2.37	0.62	0.19	0.31	0.12	13.75	8.50	5.25	2
2½	5.74	8	2.82	2.87	2.47	3.00	3.46	1.44	0.37	1.06	2.87	3.31	2.37	3.06	2.87	0.75	0.25	0.37	0.12	17	11	6	2½
3	7.54	8	3.44	3.50	3.07	3.68	4.25	1.50	0.37	1.12	3.06	3.93	2.87	3.75	3.50	0.81	0.25	0.37	0.19	17.75	11.25	6.50	3
3½	9.00	8	3.94	4.00	3.55	4.25	4.91	1.62	0.44	1.19	3.44	4.43	3.25	4.25	4.00	1.00	0.37	0.44	0.19	21	14.50	6.50	3½
4	10.66	8	4.43	4.50	4.03	4.92	5.69	1.69	0.44	1.25	3.44	5.00	3.94	5.19	4.87	1.13	0.38	0.50	0.25	23	16	7	4
4½	12.64	8	4.93	5.00	4.51						3.62	5.53	4.50	5.81	5.44	1.00				24.50	18	6.50	4½
5	14.81	8	5.49	5.56	5.05						4.12	6.25	5	6.38	6	1.00				32	24	8	5
6	19.19	8	6.55	6.63	6.07						4.12	7.28	6	7.50	7.19	1.00				36.75	30	6.75	6

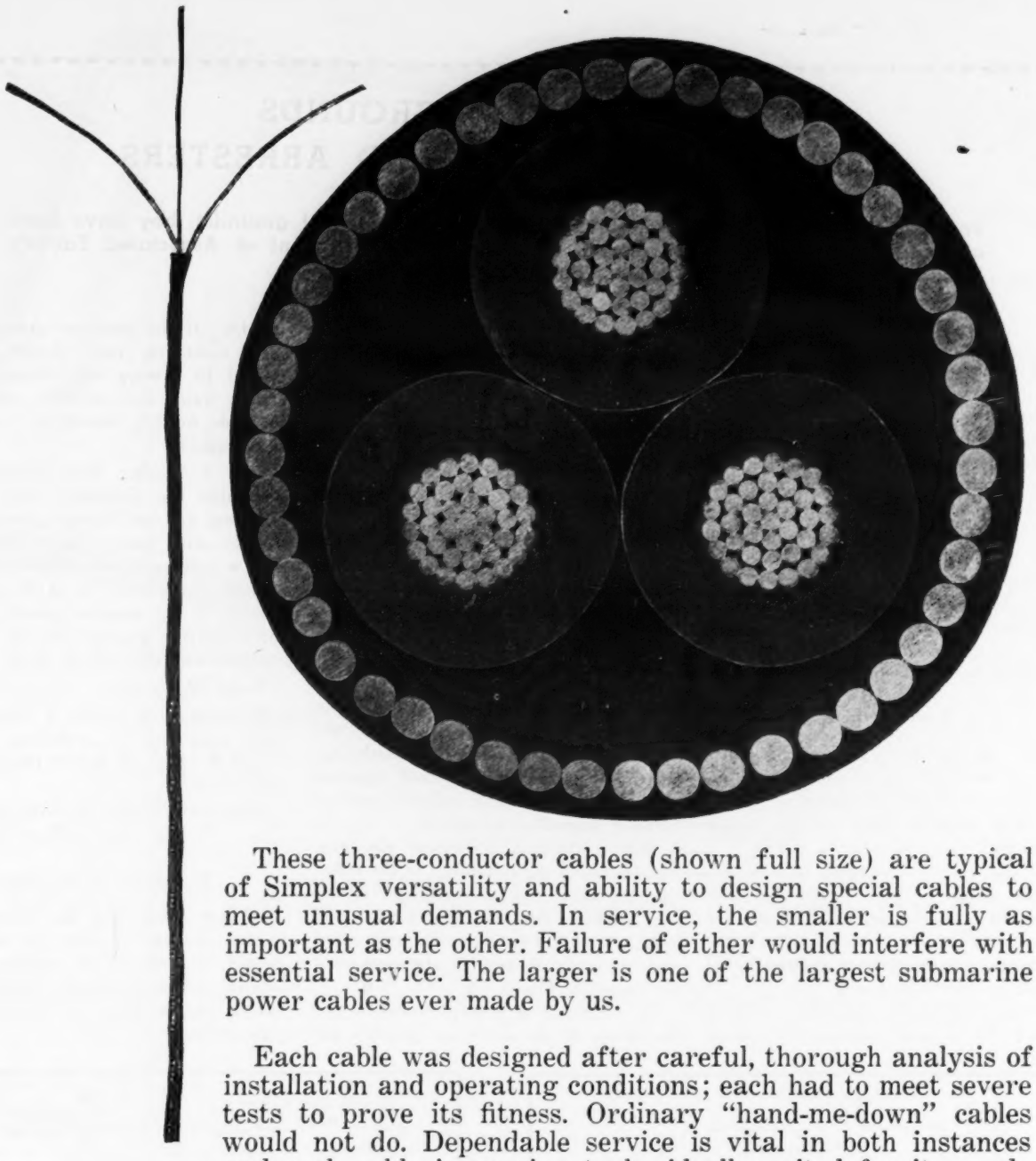
CONDUIT ALIGNMENT



Conduit Size, in.	Dimensions, inches: C	D	Q
½	0.840	1 5/16	5/8
¾	1.050	1 5/8	3/4
1	1.315	1 7/8	1
1¼	1.660	2 1/4	1 1/4
1½	1.900	2 1/2	1 1/2
2	2.375	2 11/16	1 3/4
2½	2.875	3 1/2	2
3	3.500	4 1/16	2 3/4
3½	4.000	5 1/16	2 3/4
4	4.500	5 1/16	3
4½	5.000	6 1/16	3 1/2
5	5.563	6 7/16	4
6	6.625	8	4 1/2

CONDUIT SPACING WITH ¼-IN. CLEARANCE BETWEEN LOCKNUTS

Conduit Size, In.	Dim.	Spacing, inches, for Sizes of Conduit: ½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6
½	A	1 3/16	1 1/2	1 11/16	2	2 1/16	2 1/16	2 1/16	2 11/16	3 1/16	3 11/16	3 11/16	4 1/16	4 11/16
	B	0.53	0.56	0.61	0.75	0.69	0.70	0.70	0.77	0.96	1.02	1.02	1.05	1.08
¾	A	1 1/2	1 5/8	1 11/16	2 1/16	2 1/16	2 1/16	2 11/16	3 1/16	3 1/16	3 11/16	4 1/16	4 1/16	4 11/16
	B	0.56	0.57	0.63	0.77	0.71	0.73	0.73	0.79	0.96	1.04	1.04	1.07	1.10
1	A	1 11/16	1 11/16	1 11/16	2 1/16	2 1/16	2 1/16	2 1/16	3 1/16	3 1/16	3 11/16	4 1/16	4 1/16	5 1/16
	B	0.61	0.63	0.62	0.76	0.71	0.72	0.78	0.84	1.03	1.03	1.06	1.09	1.12
1¼	A	2	2 1/16	2 1/16	2 1/16	2 1/16	2 1/16	3 1/16	3 1/16	4	4 1/16	4 1/16	4 1/16	5 1/16
	B	0.75	0.77	0.76	0.90	0.85	0.86	0.92	0.98	1.17	1.17	1.20	1.23	1.26
1½	A	2 1/16	2 1/16	2 1/16	2 1/16	2 11/16	2 11/16	3 1/16	3 1/16	4 1/16	4 1/16	4 1/16	4 11/16	5 1/16
	B	0.69	0.71	0.71	0.85	0.79	0.80	0.86	0.93	1.11	1.11	1.14	1.18	1.21
2	A	2 1/16	2 1/16	2 1/16	2 1/16	2 11/16	3 1/16	3 1/16	3 7/16	4 1/16	4 1/16	4 1/16	5 1/16	5 9/16
	B	0.70	0.73	0.72	0.86	0.80	0.81	0.88	0.94	1.13	1.13	1.16	1.19	1.22
2½	A	2 1/16	2 11/16	2 7/16	3 1/16	3 1/16	3 1/16	3 1/16	4 1/16	4 1/16	4 1/16	5 1/16	5 1/16	6
	B	0.70	0.73	0.78	0.92	0.86	0.88	0.88	0.94	1.13	1.19	1.19	1.22	1.25
3	A	2 11/16	3 1/16	3 1/16	3 1/16	3 1/16	3 7/16	4 1/16	4 1/16	4 11/16	5 1/16	5 1/16	5 11/16	6 5/16
	B	0.77	0.79	0.84	0.98	0.93	0.94	0.94	1.00	1.19	1.25	1.26	1.29	1.32
3½	A	3 1/16	3 1/16	3 11/16	4	4 1/16	4 1/16	4 1/16	4 11/16	5 1/16	5 11/16	5 11/16	6 1/16	6 11/16
	B	0.96	0.98	1.03	1.17	1.11	1.13	1.13	1.19	1.37	1.44	1.44	1.47	1.50
4	A	3 11/16	3 11/16	3 11/16	4 1/16	4 1/16	4 1/16	4 1/16	5 1/16	5 1/16	5 11/16	6 1/16	6 1/16	7 1/16
	B	0.987	1.01	1.03	1.17	1.11	1.13	1.19	1.25	1.44	1.44	1.47	1.50	1.53
4½	A	3 11/16	4 1/16	4 1/16	4 1/16	4 1/16	4 1/16	5 1/16	5 1/16	5 11/16	6 1/16	6 1/16	6 11/16	7 1/16
	B	1.02	1.04	1.06	1.20	1.14	1.16	1.19	1.26	1.44	1.47	1.50	1.53	1.56
5	A	4 1/16	4 1/16	4 1/16	4 1/16	4 11/16	5 1/16	5 1/16	5 11/16	6 1/16	6 1/16	6 11/16	7 1/16	7 11/16
	B	1.05	1.07	1.09	1.23	1.18	1.19	1.22	1.29	1.47	1.50	1.53	1.56	1.56
6	A	4 11/16	4 11/16	5 1/16	5 1/16	5 1/16	5 1/16	6	6 1/16	6 11/16	7 1/16	7 1/16	7 11/16	8 1/16
	B	1.08	1.10	1.12	1.26	1.21	1.22	1.25	1.32	1.50	1.53	1.56	1.59	1.62



These three-conductor cables (shown full size) are typical of Simplex versatility and ability to design special cables to meet unusual demands. In service, the smaller is fully as important as the other. Failure of either would interfere with essential service. The larger is one of the largest submarine power cables ever made by us.

Each cable was designed after careful, thorough analysis of installation and operating conditions; each had to meet severe tests to prove its fitness. Ordinary "hand-me-down" cables would not do. Dependable service is vital in both instances and each cable is proving to be ideally suited for its work.

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HOW TO TEST GROUNDS ON LIGHTNING RODS AND ARRESTERS

Three methods are outlined for determining the resistance of grounds; they have been adapted from Bulletin 15.66 issued by Inspection Department of Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

Ground "Megger" Method

This method is considered a simple, easy, quick and accurate procedure for determining ground resistance. An instrument known as "Megger" ground tester has been designed for this purpose. Instructions are furnished with the instrument and should be followed closely. Direct readings are automatically obtained which give the resistance in ohms.

A "Megger" insulation tester is not suitable for making ground resistance tests as it operates on direct current which is not satisfactory for the test.

Fuse Method

This is considered a simple, quick method of obtaining an approximate indication of ground resistance. Results are less accurate than by the other methods.

In this test a *grounded* 110-volt a.c. circuit should be used. A 20-amp. fuse is installed in the *ungrounded* side of the circuit which is connected to the lightning rod or arrester ground being tested, as shown in Fig. 2.

If the fuse blows when the switch is closed, the ground resistance is about 5 ohms or less. If the fuse does not blow, the resistance is too high and should be reduced to 5 ohms or less.

For this method to be successful, the ground for the 110-volt supply must be of very low resistance, such as a good electrical connection to a water piping system.

Voltmeter-Ammeter Method

This method requires two steps in the testing procedure, gives accurate results but is slow and complicated and therefore would recommend itself only where a "Megger" ground tester is not available.

Two reference ground rods (⅝-in. rod, ¾-in. pipe or angle irons) are driven 3 to 5 ft. into the earth, approximately 25 ft. apart and approximately 25 ft. from the lightning rod or arrester ground to be tested.

Step 1—Testing Reference Grounds. To determine the suitability of the reference grounds, an ungrounded 110-volt a.c. supply, an ammeter (scale 0-50 amp.), a variable resistance, and reference grounds B and C are connected as shown in Fig. 3.

If a current of 3 amp. or more can be obtained, the reference grounds are suitable. If the reference grounds show high resistance, they should be improved by driving rods deeper, or by adding water and possibly salt around the rods, until a current of 3 amp. can be obtained.

Step 2—Testing Main Ground. To determine the resistance (R_A) of the lightning rod or arrester ground at A, use the same connections as for Step 1 plus a voltmeter with 0-150 scale.

Make three tests, A to B, B to C, and A to C; connect power leads to the respective grounds and for a given current read the voltage drop.

Using Ohm's law:

R (ohms) = E (volts)/I (amp.)

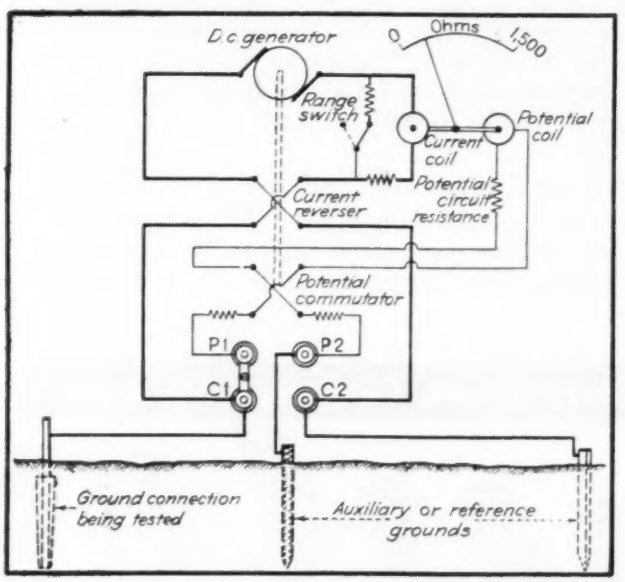
solve each test for resistance between A and B (R_{AB}), B and C (R_{BC}), and A and C (R_{AC}).

Then solve for R_A by formula:

$$R_A = \tfrac{1}{2}\ (R_{AB} + R_{AC} - R_{BC})$$

Resistance of Grounds

If tests show that the resistance to ground exceeds 5 ohms, the resistance should be reduced by making a connection to underground water pipes, buried copper plates, or driven rod or pipe ground.*



Sketch courtesy of James G. Biddle Co.

FIG. 1—Schematic connections of "Megger" ground tester

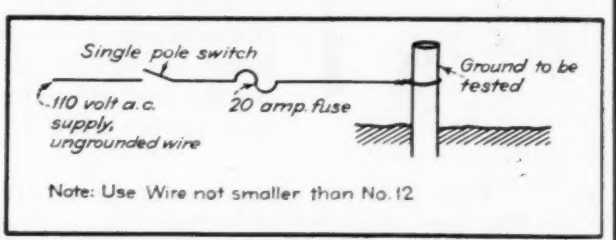


FIG. 2—Connections for fuse method

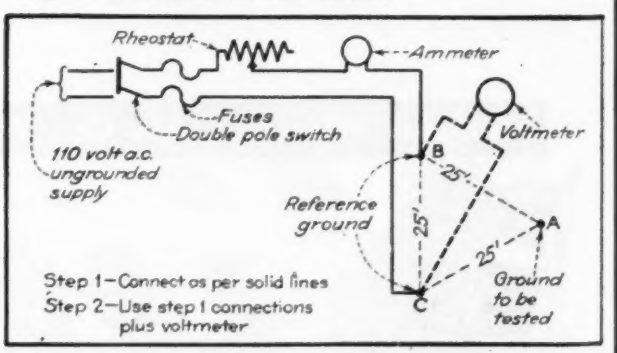
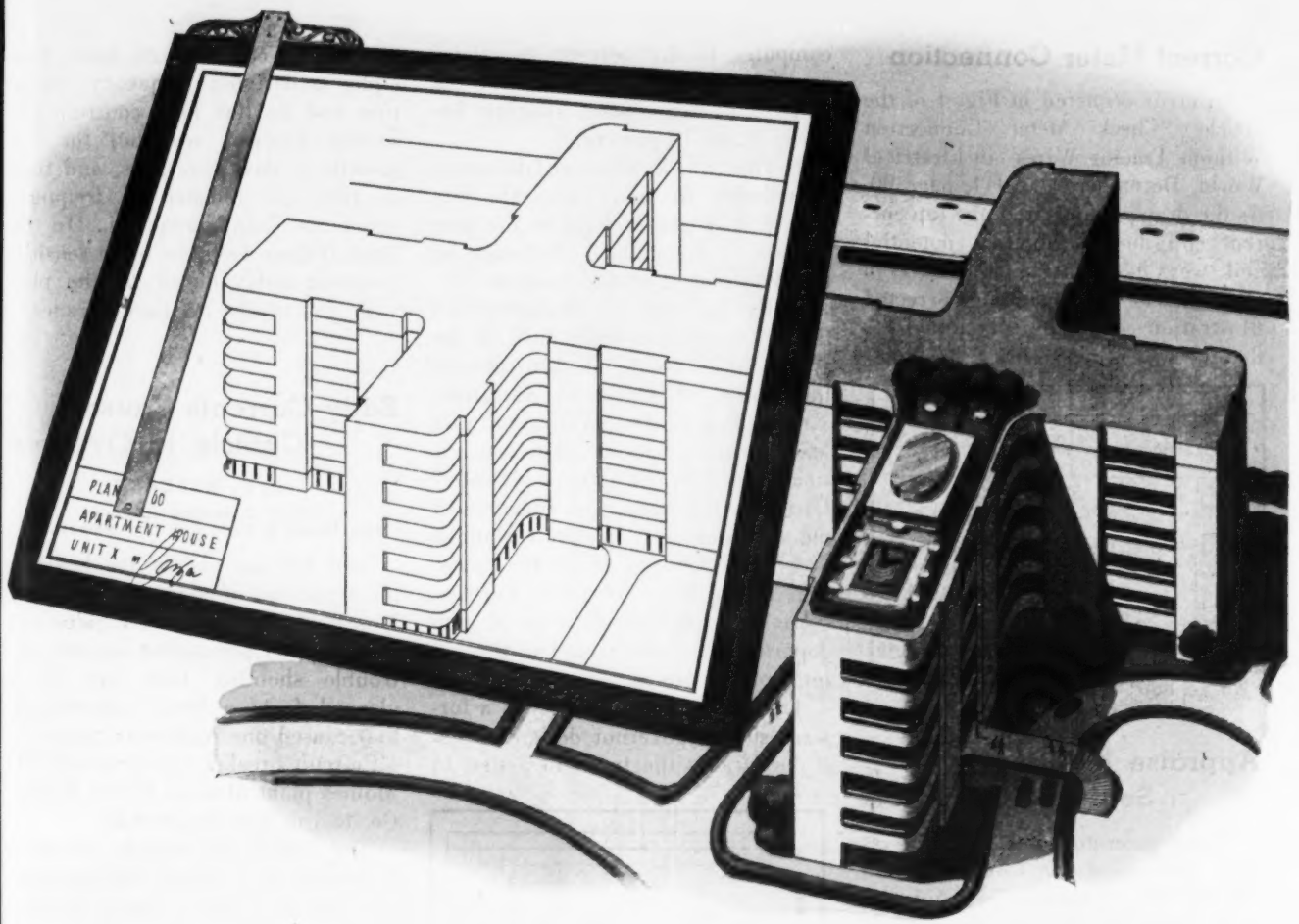


FIG. 3—Connections for voltmeter-ammeter method

*Also see ELECTRICAL WORLD, December 23, 1944, page 113 and January 6, 1945, page 82.



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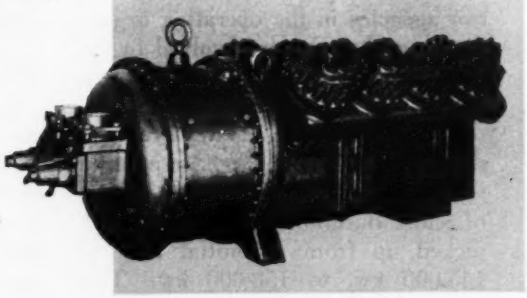

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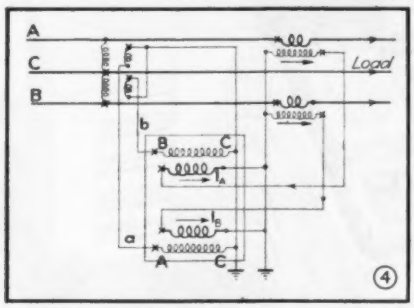
Correct Meter Connection

An error occurred in Fig. 4 of the article "Check Meter Connection Without Tracing Wires" in Electrical World, December 23, 1944, page 90. As the drawing appeared, the top current coil and the bottom potential coil were connected in parallel to ground. The accompanying corrected illustration should be substituted for the one which appeared.



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Appraise Merits of Sensitive Governors

Turbo-generator unit No. 17 at Fisk Station of the Commonwealth Edison Co., Chicago, is equipped with a governor that is almost twice as sensitive as the average on this system; experience indicates a regulation of about 5 percent for it compared with an average near 10 percent on the whole system.

This new unit (see ELECTRICAL WORLD, September 30, 1944) has been in practically continuous service carrying nearly 100 percent of its rated 147,000 kw. of capacity for 20 hr. of each 24-hr. week day period and slightly less between 1:00 a.m. and 5:00 a.m.

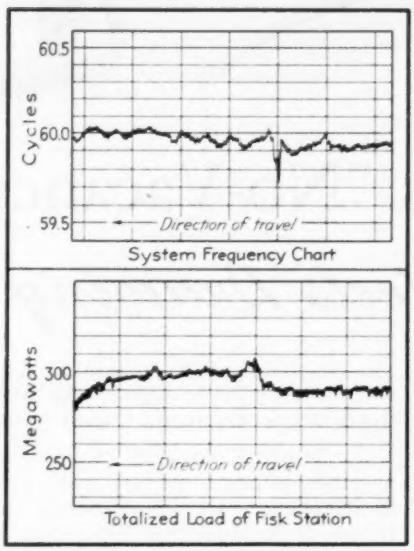
Since a governor of this sensitivity is a radical departure on the Chicago system it was deemed worthwhile to seek the opinions of men in the operating division most directly concerned with this particular operating characteristic in an effort to determine the merit of such a sensitive governor. Inquiries were directed to two agencies in the operating organization rather closely involved in the unit's behavior. A composite of these replies is given herewith:

1. The unit demonstrated its design characteristic when, during a recent momentary drop in frequency of short duration of 0.25 cycles, it picked up from an initial load of 145,000 kw. to 158,000 kw. This computes to 4.7 percent sensitivity against an average intensity for the balance of the system ranging between 8 and 10 percent.

2. This quick response definitely contributes to more accurate frequency and time control in the proportion of the units contribution to the requirement of the moment.

3. By its inherent characteristics the unit anticipates other units on the system in its contribution to correct the causes of frequency variation. The result is a certain variation in its load. This variation, however, is small and does not appreciably interfere with the base load function of the unit because frequency variations of 1/10 cycle or more are the exception rather than the rule. Furthermore, the integrated duration of such departures is rather small in the big interconnections of today.

4. This greater sensitivity is a forward step in governor design in that it encourages the trend to assign to governors, rather than to auxiliary control devices, the basic function of frequency control.



CHARTS OF SYSTEM frequency and totalized load of Fisk Station demonstrate performance of sensitive turbine governor on unit No. 17. Bulk of pick-up in total load, following drop in frequency, came from this machine (See paragraph No. 1 of article)

5. The frequency bias principle of tie line load control can well continue as an auxiliary device though more sensitive governors tend to relieve it of the unnatural function of frequency control, but retain for it the function of tie line control, an objective not in conflict with basic principles underlying frequency regulation and tie line load control. The former function was but the outgrowth of slow governors, and these in turn the dictates of frequency standards long outmoded. In the light of these facts the more sensitive governor today has a definite place with practically no encumbrance.

•

Eddy Currents Cause Cubicle to Overheat

By F. A. BEATY

Chief Operating Engineer
Iowa Power & Light Co., Des Moines, Iowa

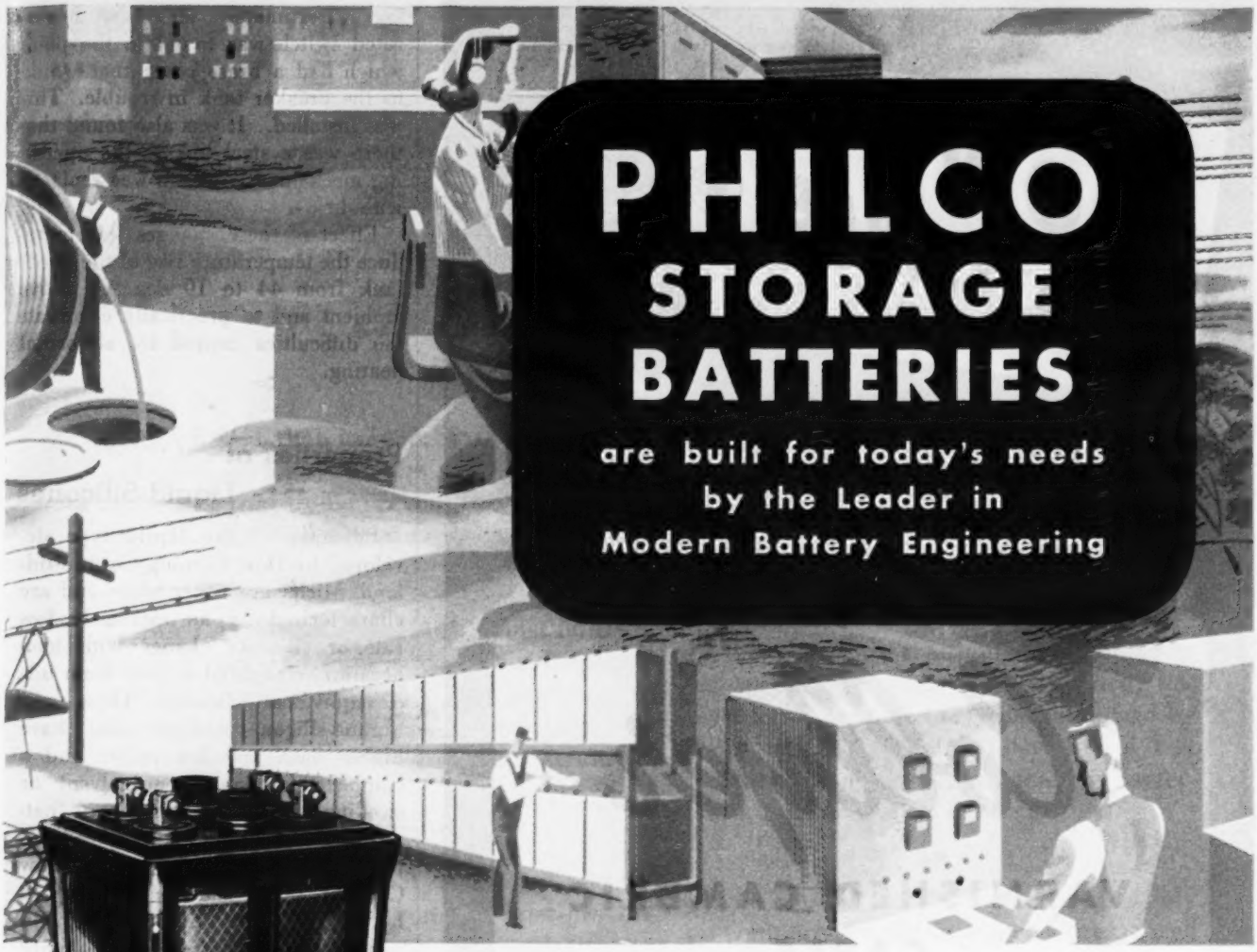
Two lessons, one in the heat-producing ability of eddy currents on the loose and the other in the value of a small pocket permanent magnet as a trouble shooting tool, are to be gleaned from a freak circumstance that caused one particular metal-clad oil circuit breaker cubicle at the Des Moines plant of Iowa Power & Light Co. to run hot consistently.

The cubicle in trouble housed a 2,400-volt three-phase station auxiliary breaker with a rated carrying capacity of 1,200 amp. The entire cubicle was running hot and had been since the load on the breaker was increased with auxiliary load when a new generating unit was added. One of the three tanks was hotter than the others and was apparently the cause of the difficulty. At two-third rated load this tank ran 44 deg. C. above ambient.

Breaker Maintenance

Maintenance of the breaker was abnormally high, due to the excessive temperature. There were deposits of carbon on the breaker busing inside the tank, oil deteriorated rapidly and the disconnect switches in the compartment were operating above normal temperature.

The manufacturer's field engineer in searching out the cause of the trouble finally found it with a permanent magnet. The magnet revealed that the cover of the hottest tank was pressed steel while the other two tank covers were of brass. Evidently a slip had been made in assembling the breaker and a steel cover was installed where a brass one should have been used in a breaker of this rating. Eddy currents in the steel cover caused the abnormal heat-



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ing. Fortunately an older lower-rated switch was found in the plant which had a brass cover that would fit the breaker tank in trouble. This was installed. It was also found that there was a steel link in the operating mechanism, this too was replaced with brass.

Effect of these changes was to reduce the temperature rise of the "hot" tank from 44 to 19 deg. C. above ambient and to practically eliminate the difficulties caused by abnormal heating.

•

Properties of Liquid Silicones

Silicones of the liquid type developed by Dow Corning Corp., Midland, Mich., are water white and are characterized by an extremely low rate of viscosity change with temperature, compared to petroleum oils of equivalent viscosity. These new organo-silicon products also have higher flash and fire points and a complete freedom from solvent or swelling effect on synthetic or natural rubber and on many kinds of plastics. They are known as Dow Corning Fluids and are not affected by oxygen under pressure at ordinary ranges of temperature. Since they are resistant to oxidizing solutions, mineral acids, salts and alkalies, they have proved to be highly useful as an impregnant for asbestos packing and gaskets in chemical pumps.

A series of the liquid silicones, known as Dow Corning Type 200 Fluids, are useful down to —40 deg. C. or up to 200 deg. C. and include medium through very high viscosity liquid silicones. They are non-volatile and possess flash points in excess of 600 deg. F. They are not miscible with alcohol glycol, glycerine or lubricating oil but will blend readily with most of the common organic solvents including light naphthas.

•

Burn Either Coal or Natural Gas

The Chickasaw steam plant of the Alabama Power Co., located near Mobile, which was designed primarily to burn pulverized coal as a fuel has been equipped in recent months to burn gas as an alternate fuel. Gas

2+2=4

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IT'S A FACT that a turbine oil must both prevent rust and have superior oxidation stability in order to qualify as a lubricant worthy of being entrusted to the lubrication of such a costly machine as a steam turbine.

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IT'S A FACT that Shell Turbo Oil was the first turbine oil to combine rust-preventive qualities with superior oxidation stability.

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IT'S A FACT that Shell Turbo Oil was the result of exhaustive research, testing and experimental work done in conjunction with the country's leading steam turbine engineers.

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IT'S A FACT that all the laboratory tests ever made do not, in themselves, prove the worth of a lubricant in actual operation . . . that samples of Shell Turbo Oil, after 40,000 hours' operation in the turbo blower of a steel mill, where other oils lasted only 5000 hours, showed not a single sign of structural breakdown. (Shell Turbo Oil has shown this same superiority under numerous equally adverse operating conditions.)

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IT'S A FACT that Shell Turbo Oil was the first of its type to be approved as meeting stringent U.S. Navy specifications 14-0-15 (INT) . . . that millions of gallons are being used yearly by the Navy in turbine service far more rugged than the operating conditions to be found on land

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IT'S A FACT that, although the Rust Test for turbine oils, sponsored by Shell, has been tentatively accepted as a standard by the A.S.T.M., there is no standard test for determining the performance characteristics of a turbine oil in service

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IT'S A FACT that Shell is the first and only oil company to design a procedure as well as an oil especially for the cleaning of turbine oil circulating systems, a phase of turbine operation that is being recognized by turbine operators as a necessity to efficient, modern turbine maintenance.

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IT'S A FACT that, in the ceaseless search to obtain as perfect a turbine oil as possible, Shell developed the "Film Tenacity" test which shows Shell Turbo Oil outstanding in resisting the constant washing effects of water.

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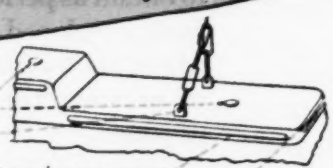

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burners were installed and a connection made with the lines of the Mobile Gas Service Corp. which distributes gas from the Louisiana field.

The Chicksaw plant has two boilers, each of 40,000 kw. capacity. The coal burning equipment of each boiler consists of twelve burners, three in each corner of the furnace. In order to burn gas the company installed five gas burners in each corner, making a total of 20 gas burners per boiler.

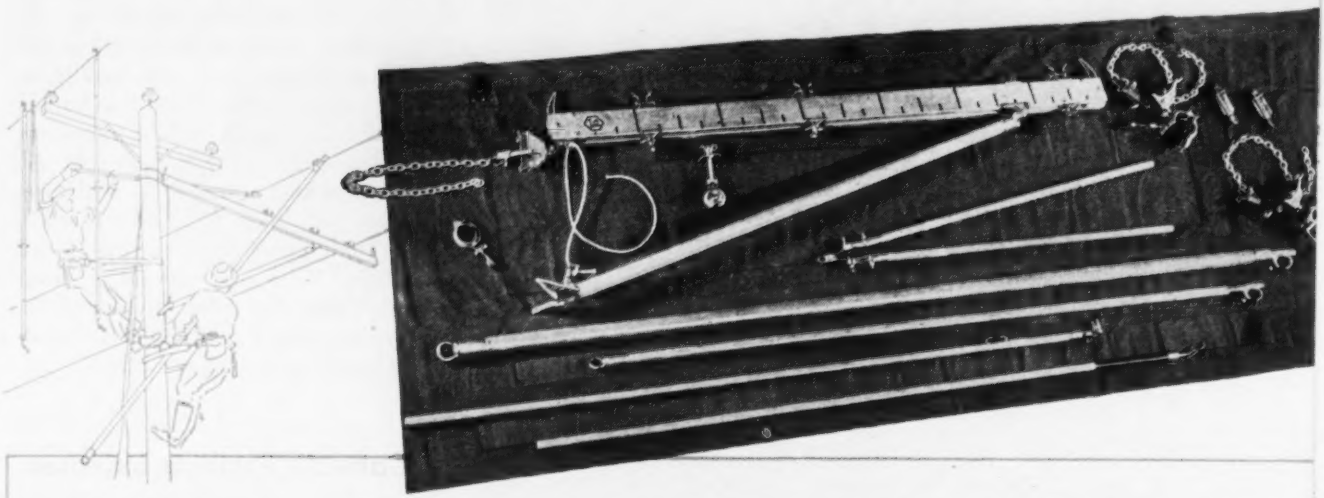
Flexibility of the installation is such that either fuel may be burned alone or both may be burned at once and in varying proportions, according to company engineers. However, certain problems arise in operation with the combination of the two fuels. Due to the difference in the chemical composition of coal and gas, the requirements of air for efficient combustion differ. This is a relatively simple problem when either is burned alone, but becomes more complicated when the two are burned at the same time in varying proportions, as the air supply must be proportioned to the quantity of each fuel being burned, and must be delivered to each boiler in the proper proportions.

Air Control

The control of total air to the burners, both coal and gas, is based on theoretical conditions including CO_2 content, fuel consumption and steam output. The control of air to the individual burners is largely by observation of furnace conditions including flame direction and turbulence within the firebox. The air control is by means of dampers in the blower supply line. In practice, operators strive for the ideal condition where a minimum amount of fuel is used to produce the desired results. Recording flow meters, one for each furnace, constantly show the amount of gas being consumed.

When operating at full load each boiler consumes about 12,000,000 cu. ft. of gas per day. For the purpose of billing and plant performance it is necessary to determine the quantity and quality of the gas consumed. Coal can be weighed in the car, but gas must be measured by volume, and all the factors affecting the volume and thermal value must be determined. The pressure, temperature, specific gravity, moisture content and thermal value are automatically and continuously recorded by means of instru-

for CONTINUOUS SERVICE · · ·
SAFETY · · · and LINE SECURITY



TIPS TOOL SET NO. 4800-10 HANDLES MANY HOT LINE JOBS

This Tips Tool set, No. 4800-10, gives you the minimum essentials for doing hot line repair work on straight line construction up to 15 KV. It may be used in a variety of ways to do a variety of jobs. The auxiliary arm may be used as a side arm or as a lifting arm in combination with the wire tongs. The wire tongs may be used together for lifting a single conductor into the clear or one tong may be used to make a straight lift.

With this set of tools a maintenance crew can remove or replace poles, cross arms, insulators, etc., in complete safety without interrupting service. It is the first step toward outfitting maintenance crews with complete equipment for handling all maintenance work hot. Additional tools may be added as the requirements demand. Many services do not require more than the few essentials shown in this inexpensive set of Tips Tools.

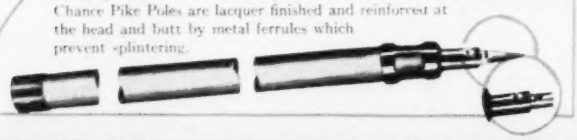
CHANCE STEEL EXPANDING ANCHORS MEET MOST GUYING REQUIREMENTS WITH HOLDING POWER TO SPARE

Because of their efficient performance under so many different soil and guying conditions, Chance steel expanding anchors have for years been the favorite of many public utilities throughout the United States; and today, they are used extensively by the Army, Navy, and Army Signal Corps throughout the world.

Chance all-steel anchors are built to stand abuse. They are practically unbreakable. They are built to do the job with power to spare. Blades expand at right angles equalizing strain at all points. The nut retainer prevents the anchor from riding up the rod during installation and permits salvaging the rod or driving it down in case the anchor is to be abandoned.

CHANCE SAFETY PIKE POLES HAVE WIRE LIFT ATTACHMENT

The point on Chance Pike Poles may be removed and reversed for safety in transportation or it may be removed and replaced with a wire lift for handling conductors, etc. Worn points can be replaced at negligible cost. Chance Pike Poles are lacquer finished and reinforced at the head and butt by metal ferrules which prevent splintering.



TIPS HOT TAP CLAMPS MAKE 3-POINT CONTACTS

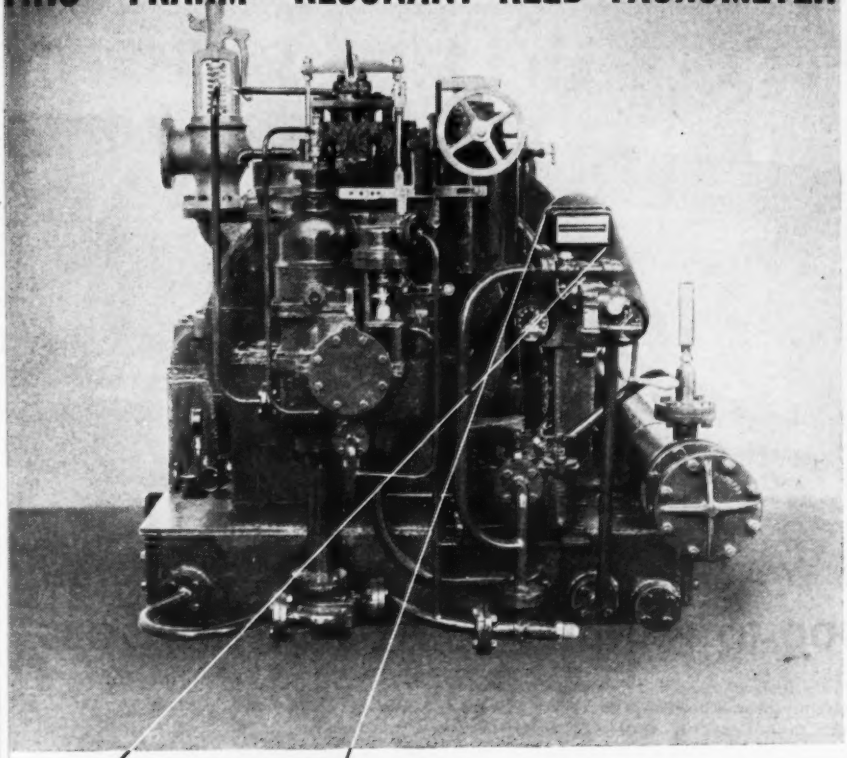
Tips Hot Tap Clamps are made to contact the conductor at three points. The U. S. S. Threads permit quick, easy application and a tight, positive grip with minimized danger of sticking due to corrosion. Made in all sizes and types for making hot line connections without interrupting service.

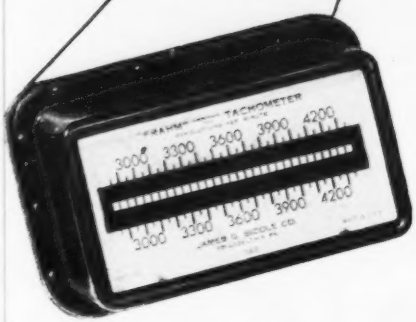
A·B·CHANCE CO·
CENTRALIA, MISSOURI.

ABC INDUSTRIES

CONSULT OUR CATALOG OR WRITE FOR DETAILS

THIS "FRAHM" RESONANT REED TACHOMETER





. . . shows Turbine speed

This is the turbine end of a 300 kw turbine-generator unit built by the Moore eam Turbine Division of the Worthington Pump and Machiny Corporation. Mounted on the panel board to give a conuous indication of turbine speed is a Frahm Resonant Reed achometer.

Frahm Tachometers are chosen for this and many similar pplications because of their extreme simplicity of construction id unfailing accuracy. Having no belts, shafts, gears, springs or elicate parts there is nothing to wear out, and they can be pended upon to function faithfully without attention—year ter year after year.

Frahm Tachometers are supplied in both stationary and ortable types, with various ranges available from 900 up to),000 r.p.m.

Write for Bulletins 1590-W and 1740-W. They give a complete description of the instruments and list all types and ranges commonly supplied.

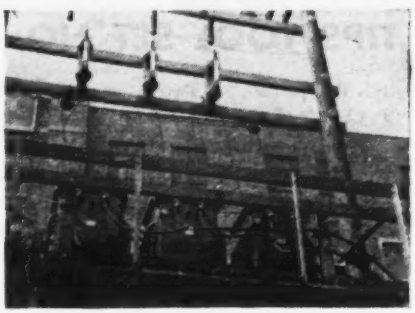
AMES G. BIDDLE CO. • **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

ments installed by the gas company. These records are summarized daily and monthly.

When gas is being utilized exclusively for fuel, a problem arises in that the coal pulverizer mills cool down and cannot be started up immediately. Under such conditions the mills are turned over occasionally, at least once a month. When it is known in advance that it will be necessary to change from all gas to all coal, the mills are kept warmed up with preheated air, bled from the furnace. The mills tend to clog up if fed moisture-laden coal without pre-heating. These and other similar problems are solved under actual operating conditions as they arrive.

•

Catwalk Protects Linemen



This is a double-purpose catwalk used on platform mounted power banks by Central Illinois Electric & Gas Co., Rockford. It is provided with a railing that keeps linemen far enough away from power fuses to prevent eye injuries from hot gases should a fuse blow accidentally while a lineman is changing it with a "hot stick." Vertical members of the same inner railing also carry secondary racks that support the transformer secondary bus.

•

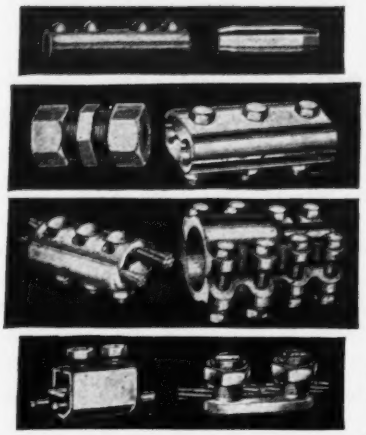
Extinguisher Kept in Its Right Place

Plant personnel never need look for the fire extinguisher if it is always restored to the place provided for it. However, since this is not always done, Thomas Dunn, engineer, Freeport Municipal Plant, Freeport, L. I., N. Y., painted an extinguisher profile of the exact size in red on a white background. Now, should the extinguisher be missing from its position the eye quickly detects it, and it is returned to its right place.

"It sure is HANDY— to have ALL kinds in One Catalog!"

For any good Straight or Parallel Connector, *see the* **COMPLETE** *line*

These illustrations can only suggest the wide variety in the Penn-Union Catalog . . . a *complete* line of Bolted Straight Connectors and Reducers . . . Screw type . . . Split Sleeve type . . . Shrink fit . . . Universal Parallel Clamps . . . E-Z Connectors that take a wide range of conductor sizes.



Also . . . the most complete line of Service Connectors, Tee Connectors, Cable Taps . . . Elbow and Cross Connectors . . . Bus Supports, Clamps, Spacers . . . Grounding Clamps, Terminal Lugs.

Penn-Union connectors are the first choice of leading utilities, industrials, electrical manufacturers and contractors—because they have found that *"Penn-Union" on a fitting is their best guarantee of Dependability.*

PENN-UNION ELECTRIC CORPORATION
ERIE, PA. *Sold by Leading Jobbers*

PENN-UNION
Conductor Fittings

● RUBBER POWER CABLES ● VARNISHED CAMBRIC CABLES ● BUILDING WIRE ● SERVICE ENTRANCE CABLE ● CRESFLEX NON-METALLIC SHEATHED CABLE ● ARMORED CABLE ●

For Wet Locations!

CRESCENT SYNTHOL TYPE SNW

BUILDING WIRE

Insulated with a special thermoplastic that is extremely resistant to ● moisture ● acids ● alkalies and oil ● inherently flame retarding ● high dielectric and mechanical strength ● bright, permanent colors ● small diameter ● easy pulling ● free stripping

SYNTHOL TYPE SNW

is approved by Underwriters Laboratories in sizes from #14 through #4/0 A W G under section 3035 of the 1940 N. E. Code for use in raceway systems, such as:

(a) Underground

(b) In concrete slabs or other masonry in direct contact with the earth.

(c) In wet locations

(d) Where the condensation and accumulation of moisture within the raceway is likely to occur.

Write for Descriptive Folder on SYNTHOL Types SNW and SN

CRESCENT

WIRE and CABLE

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

● IMPERIAL NEOPRENE JACKETED PORTABLE CABLES

LOAD SERVICING

Commercial
Industrial

Residential
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Diesel Competition — Post-War*

By J. P. McELROY
Pacific Gas & Electric Co., Fresno, Calif.

Post-war diesel engine competition for utility loads will be greatly intensified and may reach unprecedented levels. In 1943 diesel engine manufacturers produced an estimated 25 million hp. of new engines. This is about twelve times the output of 1939, and about 500 percent of the 1941 production. The war has created this tremendous increase, of course. Engine manufacturers believe contract cancellations need not bring catastrophe. They feel they can hold their industry sales at one-half of today's line. Their problem will be to find new customers for existing products without delay.

Loads served by the utilities offer a large potential market, and will, postwar, become a target for the diesel engine vendors. Electric customers seeking to save money and cut costs will be fair prey for vendors of competitive engines. The whole diesel engine picture may be summarized as follows:

There have been few radical changes in design, but many improvements tending toward lower weight per horsepower, compactness and simplicity have been made. The industrial field is not emphasized as a major market. Attention seems to be centered on smaller unit, mobile, marine, and transportation equipment. Engine prices will be lower, one manufacturer even going so far as to predict a reduction from one-third to one-half former prices. Diesel manufacturers do not fear serious competition from surplus engines produced for the war. There will be an adequate supply of diesel fuel with possibility of a slight increase in price. There is already evidence of highly organized sales promotion campaigns far surpassing any previously encountered.

Gas Engines

The gas engine situation sums up thus: There has been considerable development in the gas engine field such as lighter weight per horsepower, more reliable units, etc. It is not believed that changes of this kind will materially alter the competitive situation as far as purchased utility service is concerned. There are developments, however, which may more seriously affect the competitive situation. These consist of, primarily, three things: (1) More manufacturers are developing small engines for small loads in the commercial and small power fields; (2) practically all manufacturers are developing the "package unit" and (3) most manufacturers have developed engines which are interchangeable insofar as fuel is concerned. These engines will operate with minor mechanical changes on natural gas, manufactured gas, gasoline, or fuel oil.

Insofar as original cost of engines is concerned, all indications point to only slightly lower prices per kilowatt or horsepower. It is not believed this slight reduction in price will be a major factor in competition, but will leave the situation only slightly different from prewar conditions. It is, therefore, believed that the major competitive effort will come from development of "package units" and the interchangeability of fuels.

Competition is here. No competition is ever met successfully by subsidies, by threat, by buying it up, by under-rating, by tearing down. Every one of these methods has been employed at one time or another and found wanting. The logical way to meet competition is to render a superior service and to sell it intensively.

* Taken from a paper presented before a recent Pacific Coast Electrical Association meeting in San Francisco.

•

Georgia Power Co. Essay Contest Clicks

Designed to increase local interest in Georgia Power Co.'s "Better Home Town" program was an essay contest on the subject of home town improvement. The contest closed recently with a total of 7,118 entries which are now being studied and classified for submission to the judges.

The contest was really two in parallel, one for adults and the other for school children from whom 1,427 and 5,691 entries were received re-

CONTEST ENTRIES came in with a rush at the last moment

(Advertisement)

SYLVANIA NEWS
CENTRAL STATION EDITION

JANUARY *Published in the Interests of Better Sight and Sound* 194

Utilities Quickly Endorse Sylvania Maintenance Plan

The lighting experts of public utilities are giving enthusiastic approval to the Sylvania-sponsored plan for a complete fluorescent maintenance service, to be offered to commercial establishments by qualified electrical contractors. Lamp replacements and necessary repairs will be included in this service, as well as cleaning of lamps and reflectors.

Utilities see a maintained lighting load as the most immediate benefit accruing from the plan, since lamp outages will be eliminated by prompt replacement of old lamps.

RELIEF FROM NUISANCE CALLS

In addition, regular maintenance by contractors will free the utilities from nuisance service calls from their commercial customers—calls which now frequently occur when fixtures need repairing.

Contractors offering this maintenance service will have the benefit of Sylvania's technical assistance.

DID YOU KNOW...

That Sylvania Strobotrons, which emit pulsating light that appears to stop rapidly rotating machinery, offer valuable aid in motion studies? For example, Strobotrons are used to study the smoke patterns around moving fan blades—and from such examinations come data helpful in designing blades.

★ ★ ★

That in an installation of Sylvania Fluorescent Lighting in a broadcasting studio, the ballasts were located above a hung, soundproof ceiling? Not even the slightest hum can register in the microphones. Ballasts are mounted in ventilated metal boxes.

Sylvania Launches Nationwide Poll On Postwar Lighting Preferences

Interviews, Questionnaire Ads Will Gage Needs and Stimulate Interest

To study the lighting preferences of industry, business establishments, an domestic consumers; to stimulate interest in the subject of good lighting these are the twin objectives of a nationwide survey being launched b Sylvania Electric Products Inc. Personal interviews will be conducted wit executives in manufacturin plants, management groups i commercial establishment and domestic power users, t form one phase of this intensive lightin survey.

Linked with this aspect of the progra will be an extensive advertising campaig querying millions of readers on the lighting wants. Questionnaire-type adve tisements will appear in leading nation and general business publications.

The results of this survey, which will l reported from time to time in future issu of SYLVANIA NEWS, are expected to be of value not only to Sylvania in formulating its postwar plans, but also to public utilities in promoting better lighting.

"Pardon me, but do you plan to use fluorescent lighting in your business after the war?"

SURVEY EXPECTED TO BOOST POWER SALES

The lighting survey just initiated by Sylvania, while its primary objective is the study of lighting preference, is likely to have as an eventual by-product an increase in power sales. By making commerce, industry, and the public more conscious of the need for good lighting, the survey is expected to stimulate interest in improving present lighting levels.

Hence the utility companies may benefit indirectly through increased power sales, as well as directly in the added data which the survey will place at their command.

Sylvania's Betty Light displays the first of the survey advertisements, appearing in January national magazines.

SYLVANIA ELECTRIC

SYLVANIA ELECTRIC PRODUCTS INC., Salem, Massachusetts

MAKERS OF FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVIC

spectively. Prizes totalling $2,600 in War Savings Bonds were offered in the same number and distribution in each group—first $1,000, second $500, third $200, fourth $100, next six $50 and next 20 $25 each.

Entries came in very slowly as the closing date neared. It looked as though the people of Georgia had been able to maintain a magnificent indifference to the whole affair despite the newspaper and radio publicity promoting the contest. More than a few in the sales and advertising departments were haunted by the fear that the thing would be a flop. Then came the dead line and the post office trucks backed up to the curb and unloaded the mail bags, a portion of whose contents is shown in the accompanying illustration on a preceding page.

Tests Show Consumption of Dairy Water Heaters

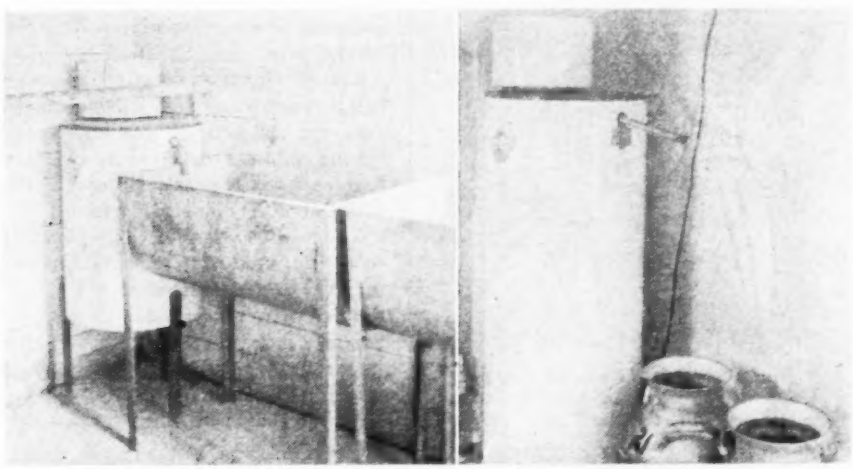
By RALPH BOWEN
Acting Promotional Director, Wisconsin Gas & Electric Co., Racine, Wis.

Test data on the operation of open-type automatic electric dairy water heaters, tabulated herewith, were gathered in 1941-1942 by Wisconsin Gas & Electric Co., Racine, from five units installed on an experimental basis under off-peak control on farms in its service area. Standard off-peak charging hours from 9:30 p. m. to 7:30 a. m., were used for the units.

Three of the test units were 20-gal. 500-watt heaters; the other two were 10-gal. 250-watt units. Unlike standard heaters of this type which are usually equipped with 110-volt heating elements those installed on the Wisconsin system were supplied with 240 volt elements. Water temperature is regulated by adjustable thermostats set at 135 deg.

All units were of the open-type, as opposed to the conventional pressure type heater commonly used in residences. With the tank of such a unit filled and the charge heated, hot-water can be drawn only by displacing it with an equal quantity of cold water. Thus, by adding a pail of cold a pail of hot is displaced from the heater for use. Open-type heaters can, therefore, be used in farm locations where no water system is available.

At present, about 300 dairy water heaters of the open-type have been connected to the Wisconsin Gas & Electric Co. system. It has not been the company's practice, however, to allow heaters of this type to be connected on the off-peak rate as independent units. Consumption of such isolated dairy water heaters, where they are the customer's sole electric water heating appliance or where they are operated in conjunction with residential heaters, is billed on the company's rural rate.



TYPICAL OPEN-TYPE dairy water heaters. (left) The 10-gal. 250-watt unit on the Rassmussen farm that serves 20-cow dairy; (right) 20-gal. 500-watt heater on Lauber farm serves 30-cow dairy. Heaters energized between 9:30 P. M. and 7:30 A. M.

Cash Savings from Better Street Lighting

By R. E. SIMPSON
Consulting Illuminating Engineer Hartford, Conn.

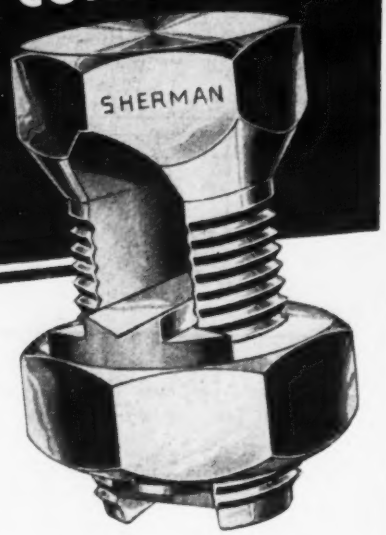
At least $90,000 per year are saved by car owners in Hartford, Connecticut, by improved street lighting which has greatly reduced the night traffic accident rate. This saving is in insurance costs only and takes no account of avoided costs of personal injury and death and of property damage.

The base year for the estimate of

Summary of Tests on Dairy Water Heaters

	10-Gal., 250 W.-Heaters						20-Gal., 500 W.-Heaters								
	Heater No. 4			Heater No. 2			Heater No. 3			Heater No. 1			Heater No. 5		
	Off Peak Kw.-hr.	Gal.	Kw.-hr. Gal.	Off Peak Kw.-hr.	Gal.	Kw.-hr. Gal.	Off Peak Kw.-hr.	Gal.	Kw.-hr. Gal.	Off Peak Kw.-hr.	Gal.	Kw.-hr. Gal.	Off Peak Kw.-hr.	Gal.	Kw.-hr. Gal.
Aug.	.....	.....	.....	.....	.....	.....	149	472	0.32	30	120	0.25	78	390	0.20
Sept.	27	100	0.27	57	210	0.27	155	420	0.37	39	180	0.22	101	360	0.28
Oct.	28	105	0.27	59	210	0.28	165	502	0.33	51	190	0.27	128	450	0.28
Nov.	39	140	0.28	36	135	0.27	155	500	0.31	56	200	0.28	153	500	0.31
Dec.	35	130	0.27	40	150	0.27	143	370	0.39	59	200	0.30	145	400	0.36
Jan.	42	160	0.26	52	200	0.26	152	500	0.30	64	240	0.27	154	500	0.31
Feb.	40	160	0.25	51	200	0.26	165	700	0.24	82	310	0.26	165	650	0.25
Mar.	31	110	0.28	39	150	0.26	146	826	0.18	96	340	0.28	128	490	0.26
Total	242	905	0.267	334	1255	0.266	1230	4290	0.287	477	1780	0.268	1061	3740	0.28
Monthly Average	34.5	129.2	.....	47.7	179.2	.....	153.7	536.2	.....	59.6	222.5	.....	132.6	467.5	
Estimated Annual	415	1550	.....	572	2150	.....	1845	6440	.....	715	2670	.....	1591.6	5610	

for More Work
Per Man Hour
Specify Sherman
SOLDERLESS
CONNECTORS



Sherman high strength silicon bronze Service Connector. Die-cut, precision threads. Full hex head, extra thick nut, solid, reinforced spacer.

S-t-r-e-t-c-h those labor hours and get more work done, by using these and other Sherman Solderless Fittings! They not only save time, but they can be installed by less experienced men. What's more, they can be salvaged and re-used.

These Sherman Connectors make strong, efficient, permanent connections. Try them! Let us send you specifications and prices.

Wedge Grip Connector.

"Bond-Rod" Ground Clamp.

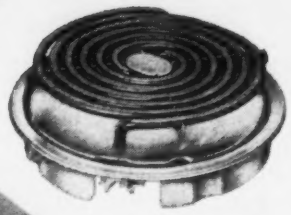
H. B. Sherman Mfg. Co.
Battle Creek, Mich.

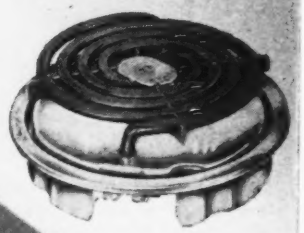
Type S-O Solderless Lug

For heavy duty service. Extra strong, with large pressure pad and corrugated gripping surfaces.

SELL T-K TODAY

Win Loyal Friends For the YEARS AHEAD





THERE ARE ONLY 2 SIZES OF T-K UNITS BUT THERE ARE 18 DIFFERENT INSTALLATION RINGS THAT MAKE THESE UNITS FIT ALL MAKES OF *Electric Ranges*

The dealer who sells quality during these trying times will have easy sailing when competition increases in the post war years. When the housewife is faced with the necessity of replacing a burned out or inefficient unit in her electric range, she relies on your technical knowledge. You know the uniformly high standard of T-K units — nickel-chromium resistance wire in perfect spiral centered in magnesium oxide. Rugged precision construction defies the extremes of heat and cold—rust—corrosion—food chemicals — steam — water and rough handling. Lift and turn principle makes cleaning easy.

* Units Raised to Cleaning Position

ALL ORDERS FOR T-K REPLACEMENT UNITS FILLED IMMEDIATELY

TUTTLE & KIFT INC.

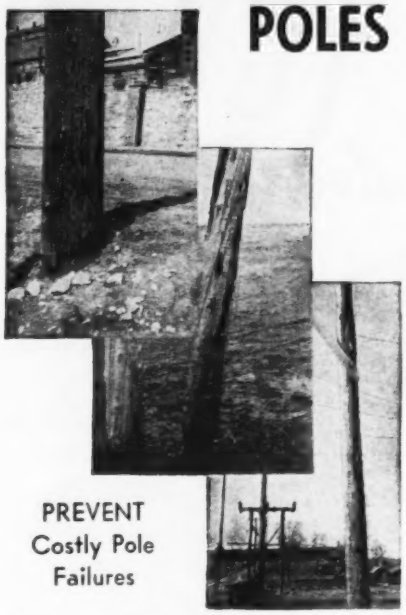
GENERAL OFFICES AND PLANT
1825 NORTH MONITOR AVENUE · CHICAGO 39, ILLINOIS

Makers of Electric Heating and Cooking Devices

PERMATOX "A"

(A Straight Toxic Wood Preservative)

For Reclaiming OLD POLES and Preserving NEW POLES



PREVENT Costly Pole Failures

With the pole shortage becoming more critical, it is vitally necessary to get the utmost service from every pole in stock or installed on your lines.

PERMATOX "A" (5% pentachlorphenol in suitable petroleum solvents) affords an effective, economical preservative treatment . . for the control of decay, shell-rot and termite attack.

Specify it for poles, posts, cross-arms, ties, crossing planks, bridge timbers and other exposed construction. Soaking or pressure treatment insure adequate absorptions and deep penetration.

•

Furnished in Two Forms:—

DOWICIDE 7

Pentachlorphenol* crystals

PERMATOX "A"

5% Pentachlorphenol* in suitable petroleum solvents

*Manufactured by The Dow Chemical Company

Write for Bulletin—Dept. E.

A. D. CHAPMAN & COMPANY, INC.

333 N. MICHIGAN AVE., CHICAGO 1, ILL.

Atlanta Memphis Portland

New Orleans New York

saving is that ended July 1, 1937, before street lighting improvements were made. In that year the night accident rate in Hartford was 11.28 per million vehicle miles. This rate is compared with the rate for the year ended July 1, 1941, which is the last year of normal traffic conditions before dim-out and other war changes. In the four years between 1937 and 1941 the lighting on approximately 30 miles of street was improved. As the result of these changes, in the year ended July 1, 1941, the night accident rate was 28.5 percent lower than in 1937.

Automobile insurance rates are based upon the number and severity of accident claims paid by insurance companies. During the period, 1937 to 1941, the price paid for insurance for a medium-priced Hartford car was reduced from $55 to $51, a reduction of $4 per car.

There were 45,041 cars registered in Hartford in 1941. State records show that, on the average, 50 percent of all cars are insured. The saving in direct insurance cost on 22,500 cars at $4 each was therefore, $90,000 for the year.

There are no records of accident costs for the 22,500 uninsured cars, but we can assume that they shared in the benefits of lowered accident costs in the same degree, and that a substantial, although unknown, amount can be added to the above $90,000 saving.

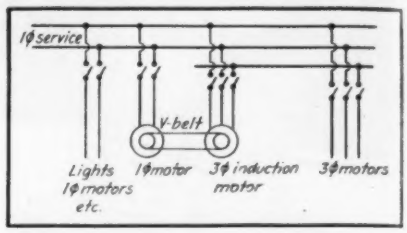
The improvement in Hartford street lighting costs $20,000 per year. This amount is returned four or five times in premium savings on insured cars alone. Adding the unknown, but surely very large, savings of other avoided costs on uninsured cars and in personal injury and property damage, makes the additional cost of better street lighting small indeed.

•

Getting Three-Phase from Single-Phase

A small machine shop subcontracting on war work was assigned lathes by the government which were equipped with three-phase motors and controls for high-speed reversal. Being in a residential area, only single-phase energy was available. Although the total motor rating involved was but 3 hp., a change to single-phase motors was out of the question from the standpoints of cost, time required, and suitable control facilities. A standard motor-generator set was unavailable, and it was undesirable to install an internal combustion engine-driven unit even if one could have been found.

The key to the solution, which was facilitated by the local utility power sales department, was the recollection of the Norfolk & Western Railroad



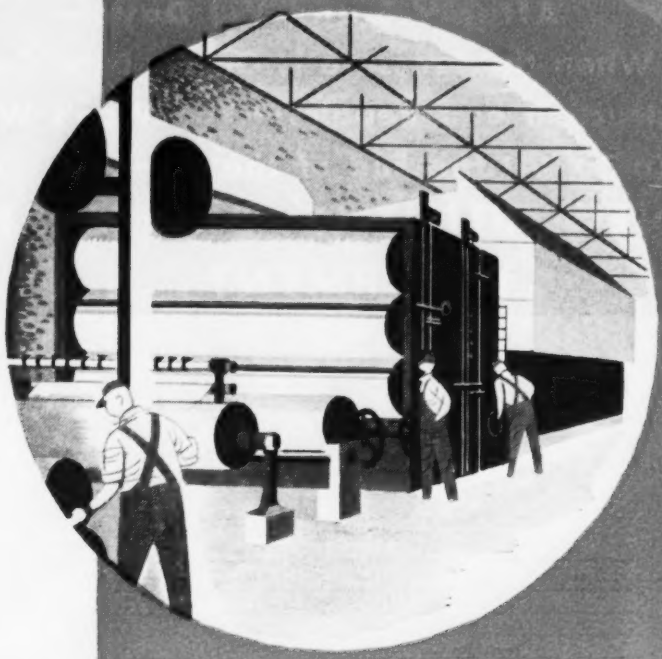
CONNECTIONS of motor-generator set to supply three-phase energy to small industrial plant in war work

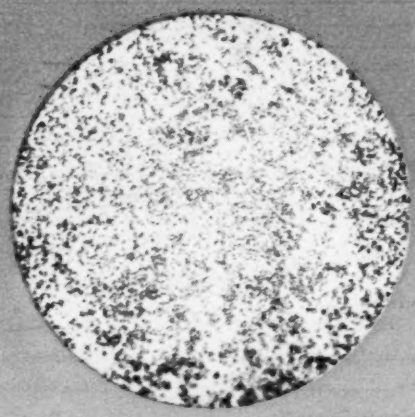
electrification, where single-phase energy is supplied from the trolley and converted by an induction motor-generator set in the locomotive to polyphase energy for ultimate use in three-phase induction traction motors. In the case of the industrial plant a motor-generator set was made up consisting of a 10-hp., single-phase induction motor V-belted to a 10-hp., three-phase induction motor as indicated in the diagram. One phase of the three-phase motor is excited from the single-phase supply. The induced field of the spinning rotor reacts upon the two remaining generator phase windings to provide, with the single-phase supply, a supply which proves satisfactory for operation of the several small three-phase motors even though the voltages are vectorially distorted.

It was thought desirable to drive the three-phase motor at a slightly higher speed than the single-phase motor (1,850 and 1,750 r.p.m. respectively). Motors of 10-hp. rating were available, although a smaller single-phase motor would do because once the three-phase motor is spinning and excited, it will continue to run as a single-phase motor. The output capacity is limited by the necessity for the power delivered by the two generator phases to be supplied through the excitation phase winding, and also because phase relations are distorted and the internal power-factor poor. While the set is obviously not very efficient, the motors were quickly procurable and

ONE OF THE MANY DOW CHEMICALS USED BY AMERICAN INDUSTRY

how the electrical industry wrapped up a moldy problem





Moisture means mold. Mold makes costly inroads on profit. That's why the experience of the wrapping paper industry with Dowicide is interesting and important to many others confronted with mold problems.

Wrapping of soap has long been a major problem. Paper used for this purpose is subject to mold attack because of the high moisture content of soap. Moldy packages caused housewives to reject the product. To lick the problem, Dow technicians were called. They investigated . . . experimented . . . went into a huddle . . . came out with Dowicide.

The years have proved the success of Dowicide. Today, many high-moisture products are wrapped in Dowicide treated paper.

In fact, Dowicide has licked many other mold problems in the paper industry, as well as in other fields such as paint, textile, lumber, and many more. If you have a mold problem, write us to find out how Dowicide can help you.

THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit
Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle

Dowicide

Germicides and fungicides

DOW

CHEMICALS INDISPENSABLE
TO INDUSTRY AND VICTORY

After V-E and V-J Days—
When the Pressure Is On for New Construction and Repairs—You Won't Want To Be "*At the End of the Line*" for Your
NEW UTILITIES' BODIES AND EQUIPMENT . . .

American Wishing to Deliver to You the Utmost In Service, Seeks Your Cooperation By the Filling In Of This Proposal to Purchase Utility Equipment

To—The American Coach & Body Co.
9503 Woodland Avenue, Cleveland, Ohio

We propose to purchase the following American Coach Utility Equipment to be delivered F. O. B. Cleveland, Ohio immediately that new truck chassis become available.

Quantity	Description	Model	Length	Make of Chassis
	Line Construction Bodies			
	Crew Compt. Bodies			
	Seven Man Cabs	3980		
	Cab Conversions			
	Tree Trimmer Bodies	4078		
	General Service Bodies	4460		
	Light Line Service Bodies	4460-L		
	General Utility Compt.	4804		
	Telephone Installation Bodies	L I U		
	Rural Maintenance Bodies	4451		
	Gas Meter and General Service	3979		
	Pole Trailers			
	Cable Splicers' Cart	50-B		
	Aerial Ladders			
	Bodies to our specifications	Special		

As soon as governmental restrictions on the manufacture and sale of utility equipment are terminated, you are to mail price quotations, at which time the agreed upon prices and delivery dates will be incorporated into a firm order in writing. Should we fail to issue a firm order within 30 days after receipt of your price quotations, this proposal shall be automatically cancelled and our name shall be removed from your "preferential delivery list."

Accepted for
THE AMERICAN COACH & BODY CO.

By.....
Title.....
Preferential Delivery No.....

Dated this.....day of.....,19.....
Company.....
City and State.....
By.....

The American Coach REPLACEMENT PLAN Will Save You Time and Worry—

It will certainly pay you to get the full details of this plan for it will assure you early delivery of the Utilities' bodies, winches, power take-offs and other equipment that will be needed so badly to replace and augment your present hard pressed and hard worked equipment.

Participation in this plan does not place you under any obligation. Complete details and copy of proposal form, illustrated above, will be sent on request, write today for it and save time and worry—

HELP SPEED VICTORY
BY BUYING MORE WAR BONDS

THE *American* COACH & BODY CO.
PUBLIC UTILITIES EQUIPMENT FOR MOTOR VEHICLES

other methods required reactors and capacitors for phase displacement which were less readily obtainable.

•

Promotional Program of San Diego Utility

Although the San Diego Gas & Electric Co. will not merchandise electrical appliances after the war, a promotional program designed to aid independent electrical dealers in becoming strong merchandising outlets is now being planned, according to E. W. Meise, domestic sales engineer for the company.

Electric range and water heater sales will be promoted by a field representative, who will aid dealers in sales campaigns, organize cooking schools, improve window displays, furnish "live" prospects, and keep dealers notified in advance of contemplated extensions of electrical service. A second representative will render similar aid to dealers in the sale of table appliances, dishwashers, disposals, washers, dryers, ironers, vacuum cleaners, radios, and refrigerators.

Home lighting sales, which, according to Mr. Meise, are expected to offer the greatest overall expansion possibilities in the postwar period, will be promoted by a third representative; he will help conduct dealer lamp bulb campaigns, give assistance in lighting layouts for new homes, promote dealers' sales of fixtures and portable lamps, and assist dealers in improving lighting displays and sales methods.

Because the inadequate wiring of many San Diego homes forms a major "bottleneck" to the sales and use of appliances, a fourth representative will specialize in selling better wiring to architects, builders, and electrical contractors. He will also keep financial institutions advised as to what constitutes proper wiring and what poor wiring does toward making investments insecure and homes obsolete. This representative will assist architects and prospective home owners in laying out proper wiring.

In addition to the four special field representatives, home economic demonstrations will be employed to assist in developing leads on major appliances for the dealers and in maintaining interest in the quality grade of table appliances.

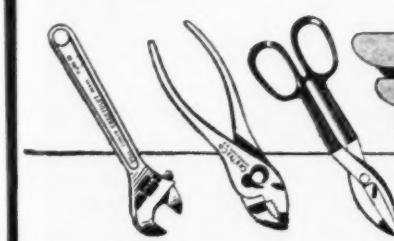
Designed to Cut, Cut Fast *and* Keep cutting

Whether you use snips or sell them . . . cutting ability is their prime virtue. Crescent Snips are well known for their fast, easy cutting. They should be because they were designed for that purpose alone. Special methods of grinding are used to assure absolute uniformity with the master pattern. Balance and proper leverage are also part of Crescent Snips appeal to experienced mechanics . . . they "feel" right as well as *cut right.*

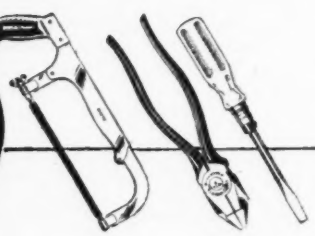
Crescent Snips . . . like other famous Crescent Tools . . . have been "off to the wars," but some day soon we hope, they'll be back in the hands of good mechanics and readily available over the counters of good hardware dealers everywhere.

CRESCENT TOOL COMPANY, JAMESTOWN, N.Y.

ARMY (E) NAVY

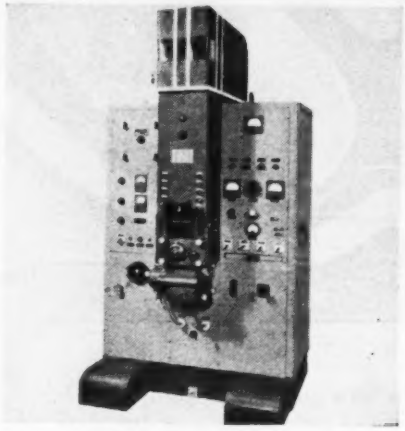


CRESCENT TOOLS
Give Wings to Work



NEW EQUIPMENT

Oscillograph



Cold cathode type electronic oscillograph; **Westinghouse Electric & Mfg. Co.**, P. O. Box 868, Pittsburgh 30, Pa.

Instrument is reported as capable of recording single electrical transients with respect to time, or two electrical phenomena with respect to each other in the form of diagrams produced by two pairs of electrostatic deflecting plates disposed at right angles to each other. The unit consists of the oscillograph proper and the cabinet which houses the energizing and control circuits. All terminals are enclosed except one connected to the source of synchronizing impulse. Has fluorescent screen for direct observation and stationary holder for film recording of the phenomena.

•

Insulated Brush

Insulated brush; 36-in. long; **Industrial Products Co.**, 2820 N. Fourth St., Philadelphia 33, Pa.

An insulated brush especially designed for cleaning around electrical apparatus in power plants and substations. It has a 3-ft. straight-grain wood handle and is provided with a hand guard to protect user from slipping and possible contact with the conductor. The 8-in. section above the hand guard is reported to be made of nonconducting fibre. Brush section is made of 3-in. bristles and is 11-in. long.

Resistor

"Thermistor" resistance element; temperature coefficients as great as 5 percent per degree C. **Western Electric Co.**, 195 Broadway, New York 7, N. Y.

Small circuit element made of a mixture of metallic oxides characterized by high negative temperature coefficients, suitable where temperature changes can be produced. Resistance lowered when element is heated externally (by ambient temperature rise), directly (by flow of current in element and heat produced internally), and indirectly (by energized coil placed around and heating the element). Approximately 40 types available. Typical is a nitrogen-filled glass bulb unit with two terminals, having approximately 50,000 ohms at room temperature and 500 ohms when 100 milliwatts is applied. They can serve functions such as stabilization, temperature compensation and time delay.

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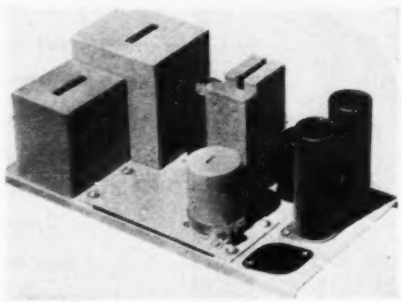
Amplifiers

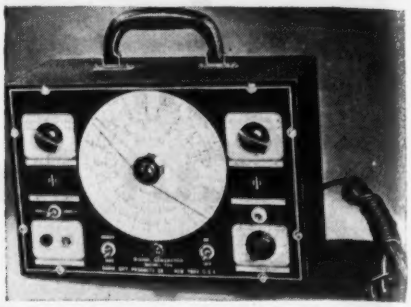


Amplifiers, 102 series; **Langevin Co., Inc.**, 37 W. 65th St., New York City.

Amplifiers said to meet frequency modulation requirements as to frequency response, power output versus distortion, and noise level. Consists of four types: 102-A, with input impedances of 30/250; output impedance 350 ohms; frequency response 30/16,000 cps.-0.5 db. Type 102-B is a 3-stage unit with a reported gain of 95 db. Employs input stage electronic mixing, and is intended for public address systems. Type 102-C consists of a 3-stage amplifier, fixed gain, adjustable, 751 85/95 db. and type 102-D, a 2-stage amplifier with input impedance of 600 ohms and bridging. This unit is said to have fixed gain of 600 ohms, input of 61 db. and bridging input of 45 db.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Signal Generator



Model 704 signal generator; range 95 kc. to 100 mc.; "on-off" indicator; double-fused line cord; **Radio City Products Co.**, 127 W. 26th St., New York 1, N. Y.

Unit has a planetary drive condenser with direct reading calibration. Output can be modulated or unmodulated. Self-contained modulation is either 400 cycle or 1,000 cycle sine wave which modulates carrier. The units range is from 95 kc. to 100 mc. Fundamental frequencies said to be continuously variable from 95 kc. to 25 mc. in five bands. Calibration is reported to be within 2 percent per band up to broadcast band and within 3 percent for high frequency bands. Among protective features reported are automatic shorting of coils not in use; individual shielding of R. F. circuits, coil assembly and attenuator; and overall steel case, chassis and panel.

•

Ferrograph

Ferrograph; scale 10 divisions per inch; operates on 115 v., 40-60 c.; dimensions 12½ by 17¼ by 23¾ in.; wt. 100 lb.; **Allen B. Dumont Laboratories, Inc.**, Passaic, N. J.

Instrument provides comparisons of ferrous materials as to analysis and heat-treatment by utilizing the transformer principle of operation. A 23-cycle exciting current is fed into the primary coil while the output of the secondary is controlled by the magnetic characteristics of a metal sample introduced into the coil. Voltage from the secondary is filtered and the fundamental 23-cycle is impressed on the horizontal of the cathode-ray tube. The third harmonic is viewed on the vertical axis of the instrument. The first and third harmonics vary in phase and amplitude with variations in the analysis and heat-treatment of steel or iron.

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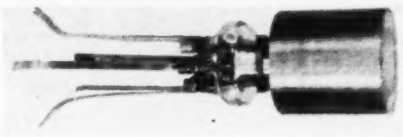
Power Tube

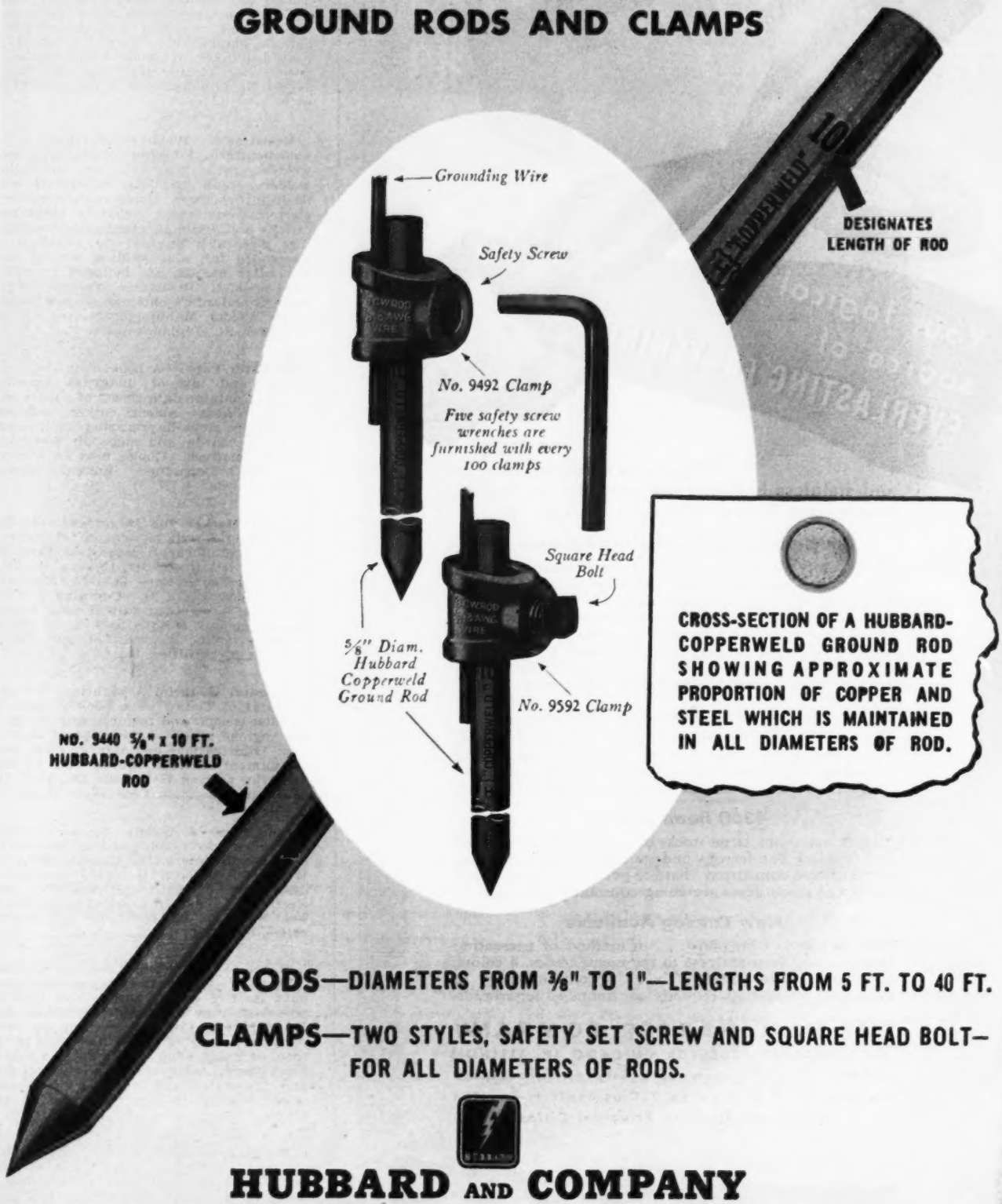


Type F-5302 water cooled and F-5303 forced air cooled tube; 3,500 watts up to 50 mc.; max. ratings (d.c. plate v. 3,500; d.c. plate current 1.0 amp.; plate dissipation 1,200 w.); filament current 27.5 amp. at 11 v.; 7-in. high and 3½ in. diam.; **Federal Telephone & Radio Corp.**, 32 Central Ave., Newark 1, N. J.

Compact, power tube which has 6-in. capped leads permanently attached to the tube terminals, is said to have an oversize filament and an extra-heavy anode wall. Leads are said to eliminate glass damage and permit installation and maintenance by inexperienced personnel.

HUBBARD-COPPERWELD

GROUND RODS AND CLAMPS


Grounding Wire
Safety Screw
No. 9492 Clamp
Five safety screw wrenches are furnished with every 100 clamps
Square Head Bolt
5/8" Diam. Hubbard Copperweld Ground Rod
No. 9592 Clamp
DESIGNATES LENGTH OF ROD
NO. 9440 5/8" x 10 FT. HUBBARD-COPPERWELD ROD
CROSS-SECTION OF A HUBBARD-COPPERWELD GROUND ROD SHOWING APPROXIMATE PROPORTION OF COPPER AND STEEL WHICH IS MAINTAINED IN ALL DIAMETERS OF ROD.

RODS—DIAMETERS FROM 3/8" TO 1"—LENGTHS FROM 5 FT. TO 40 FT.

CLAMPS—TWO STYLES, SAFETY SET SCREW AND SQUARE HEAD BOLT—FOR ALL DIAMETERS OF RODS.

HUBBARD AND COMPANY

EXCLUSIVE NATIONAL SALES AGENT FOR
COPPERWELD GROUND RODS AND CLAMPS

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Specializing on Everlasting Fastenings

Harper specializes on non-ferrous and stainless bolts, nuts, screws, washers, rivets and accessories . . . is not concerned with common steel. The Harper engineering and manufacturing staffs are composed of men who have concentrated on the working properties and peculiarities of brass, copper, bronzes, Monel and stainless steel. Through long, practical experience, they have built up a vast fund of specialized "know how."

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The plant houses hundreds of machines, some standard, some special . . . machines for heading, forging and threading huge fastenings and small . . . all engineered to do the best job on non-ferrous and stainless alloys.

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TECHNICAL LITERATURE

Paper and Paperboard—is the title of a publication which has a discussion on the nature of paper properties and on the significance of more commonly used tests, defines terms and nomenclature of properties of paper related to these tests, and has a chapter covering the action of water and its significance. Copies of the 120-page book are available from American Society for Testing Materials, 260 South Broad St., Philadelphia 2, Pa., at $1.50 each.

Resistance Welding—Standards for nomenclature, definitions, horn type spot welders, press type spot and projection welders, seam welders, upset-butt and flash-butt welders, stored-energy welders, electrical equipment including equivalent ratings and limits of transformer temperature rise, also a chart for selection of electrodes for spot welding similar and dissimilar metals, are included in a 68-page booklet, "Resistance Welding Equipment Standards," obtainable from Resistance Welder Manufacturers Association, 505 Arch St., Philadelphia 6, Pa.

Transfer Paper—A booklet on the technology and use of linagraph transfer paper. Contains data sheets of papers and plates. Also, among other subjects treated are steps in preparing luminescent drawing boards and steps in preparing X-ray negatives. Copies may be secured from Sales Department, Eastman Kodak Co., Rochester 4, N. Y.

Farm Market for Manufacturers—Report No. 158 will be sent to executives, schools and libraries requesting them on business letterhead by George S. May Business Foundation, 840 N. Michigan Ave., Chicago 11, Ill. Contains a word picture of the rural post-war sales opportunities, points out the backlog of wants, farmer's financial condition and future markets for utilities, etc.

Hospital Lighting—"Lighting for the Hospital of Today" is a booklet containing discussions and requirements of lighting various areas of this type of institution. Illustrations and diagrams are used to augment the text. Copies may be procured by writing Holophane Co., Inc., 342 Madison Ave., New York 17, N. Y.

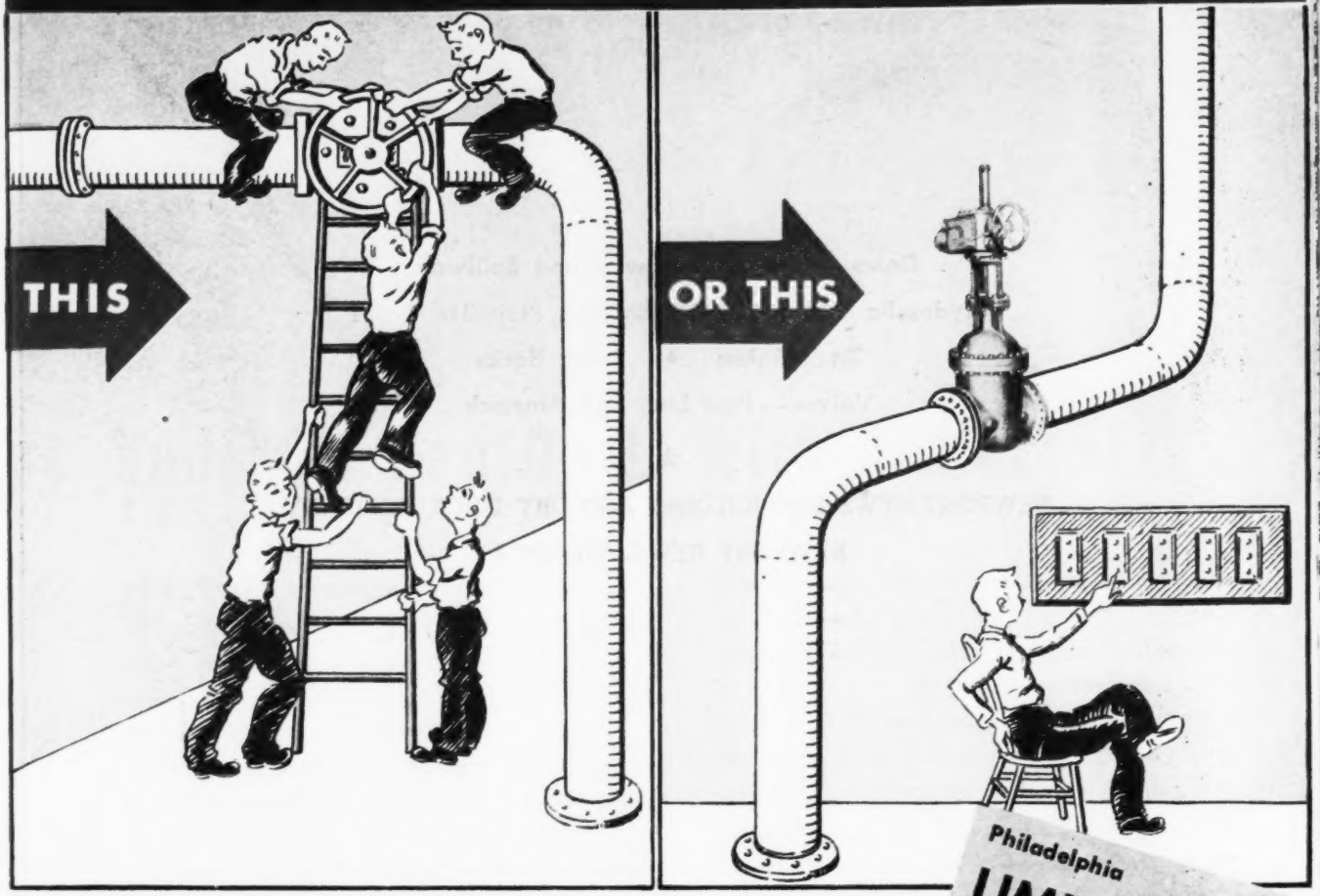
Electrodes—A bulletin on arc welding electrodes may be obtained by addressing the Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. The bulletin (L 6348) contains a description of both a.c. and d.c. type electrodes, charts on physical properties of weld metal for the electrodes and current values by sizes.

Manual—An 80-page Duronze Manual containing specifications and technical data on five copper base alloys may be procured from the Bridgeport Brass Co., Bridgeport 2, Conn. by writing on company stationery. Data on the alloys in the form of sheet, strip, rod, wire, and tubing are given in tables and charts. Discussed and illustrated are examples of product improvements through the use of the alloys.

Welding—Bulletin WP-44 entitled "Resistance Welding at Work" is a 60-page booklet which is designed as a guide to the uses to which resistance welding is adaptable. Spot or multiple spot, seam or flash, butt or projection welding are treated in its pages. Information based on current practices in fabricating a great diversity of products from aluminum and many types of steels is also listed. Copies may be secured from Progressive Welder Co., 3050 E. Outer Drive, Detroit 12, Mich.

WHICH *method of valve operation*

SAVES TIME
SAVES TROUBLE
PROVIDES GREATER SAFETY



Philadelphia LIMITORQUE VALVE CONTROLS

The striking contrast between opening or closing similarly sized valves manually or with LimiTorque Valve Operators is clearly demonstrated in these drawings. LimiTorque Controls enable one man to operate valves up to 96" diameter by merely pushing a button at a centrally located master control panel or a convenient individual push button station. This permits the valve to function at maximum desired speed while eliminating all physical hazards to the workmen.

Remote operation of valves from one central point with a full knowledge of their status at all times is entirely practical with LimiTorque. There are several types of LimiTorque Controls applicable for operating all types and sizes of valves and which can be adapted to existing equipment if desired. Floor stand controls can be furnished where it is not practical to fit the controls directly to the valve yokes.

Write us for more details . . . on your business letterhead, please

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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Gates — Intake, Sluiceway and Spillway

Hydraulic Turbines — Francis and Propeller Types

Rack Rakes • Trash Racks

Valves — Pipe Line and Penstock

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NEWPORT NEWS, VIRGINIA

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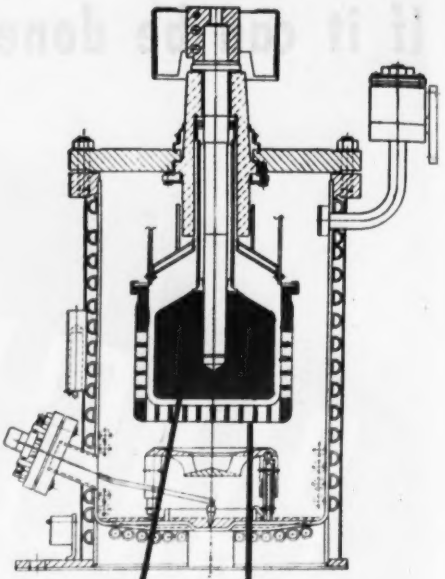
"Unless you can express it as a *Number* you have no information"



THAT'S AN UNWRITTEN LAW in many laboratories today. Because "National" graphite's purity—99.979%—could be expressed as a number, the manufacturer's engineers knew what its performance characteristics would be when used as the anode and anode shield material in this Ignitron Rectifier.

Across the nation, banks of these rectifiers are serving war plants, traction companies, shipyards and mills efficiently and dependably.

Engineers have long known that graphite does not fuse, soften or warp, and has nearly perfect heat radiation properties. Thus, in many types of both vacuum and gas-filled industrial and radio tubes where great heat must be dissipated, or where warpage of multiple tube components must be prevented, graphite is the ideal material.

As pioneers in the carbon and graphite manufacturing business in America, National Carbon Company has brought to highest perfection the art of making high-purity graphite. That is why "National" High-Purity Graphite is most frequently specified for vital industrial and radio tube components. Graphite of even higher purity is supplied for some applications. We welcome the opportunity to discuss the advantages of this "National" electronic graphite.

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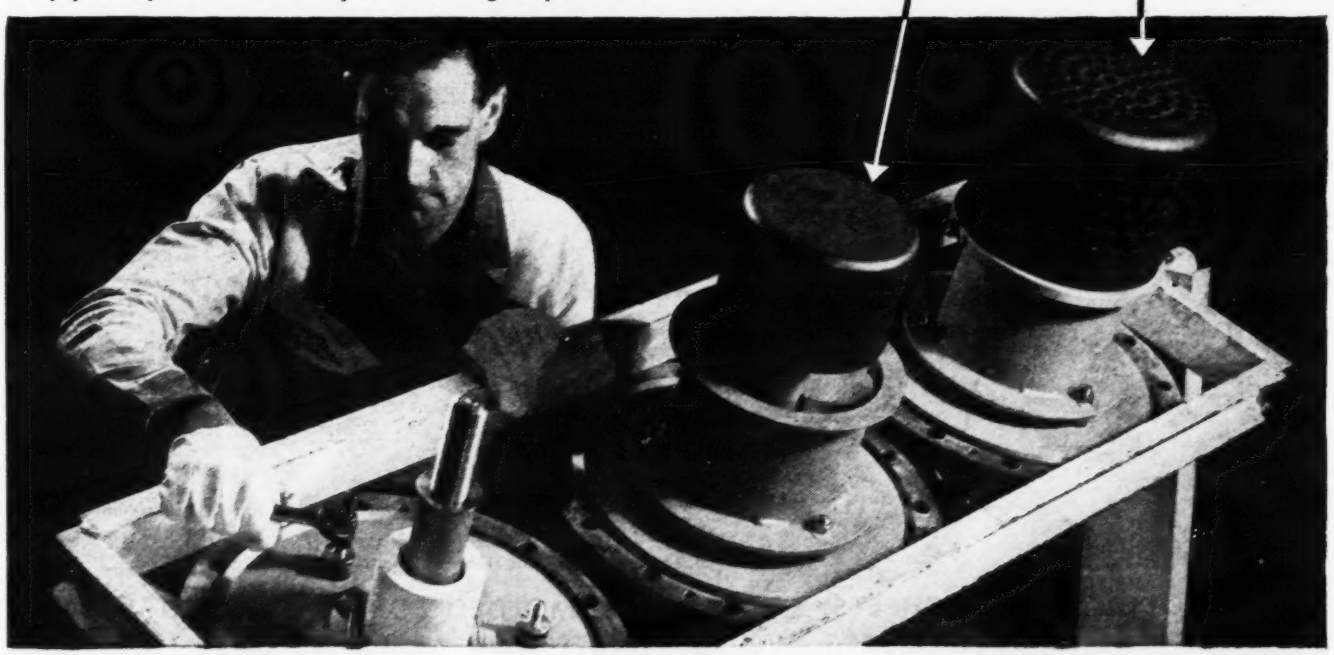
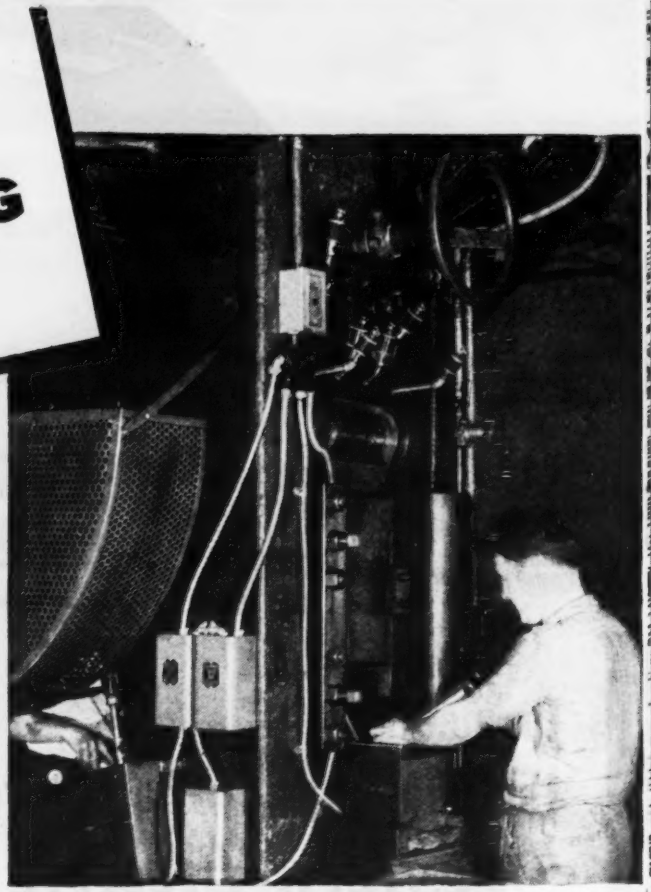
The registered trade-mark "National" distinguishes products of National Carbon Company, Inc.

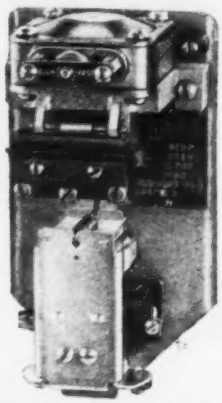
Keep your eye on the infantry . . . the Doughboy does it!



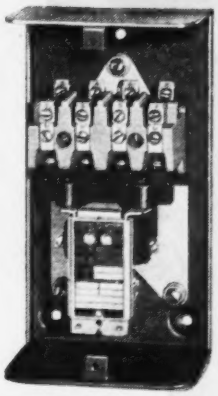
SQUARE D HEAVY DUTY CONTROL & TIMING RELAYS



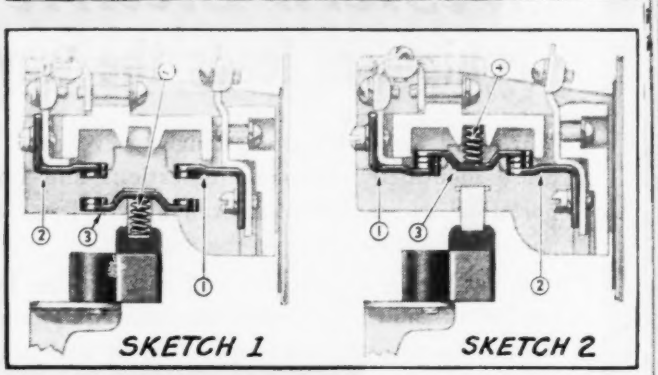
"Naturals" for reconverting or modernizing electrical control because they're designed for simplicity of operation and flexibility of application.



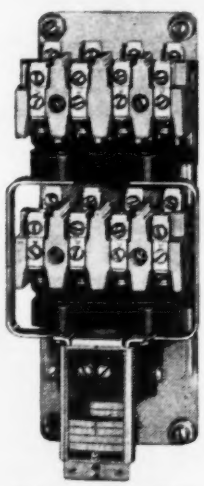
Class 9050 timing relay for .2 to 180 seconds delay.



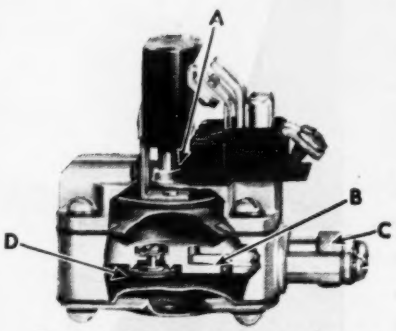
Class 8502 Type R four pole relay.



Sketches show how any pole of a Type R relay can be changed from normally open to normally closed (or vice versa) without additional parts. When parts numbered 1, 2, 3, and 4 in sketch 1 are removed and reassembled as in sketch 2, the contact is changed from normally open to normally closed.



Eight pole Class 8502 Type R relay.



Timer mechanism cutaway showing construction and method of operation. Spring action (A) moves contact member as quickly as air can transfer from lower to upper chamber through the restricted orifice (B). Turning the knurled wheel (C) regulates amount of restriction. A check valve (D) allows instantaneous resetting.

Write for Bulletins 8502 and 9050. Square D Co., Industrial Controller Div., Milwaukee 12, Wis.

Call in a Square D Field Engineer

Your nearest Square D field engineer can help you find the right answers to your problems in expanding or modernizing electrical control systems. This counsel is available, without cost, through branch offices located in 50 leading U. S. and Canadian cities.

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It's human to take the "little things" for granted. Yet, a goodly percentage of the electrical troubles . . . in your plant, or in your products in your customer's plant . . . are due to nothing more than poor connections. *Check with your maintenance or service men on this point.* Then you will agree that more attention should be given to electrical connections.

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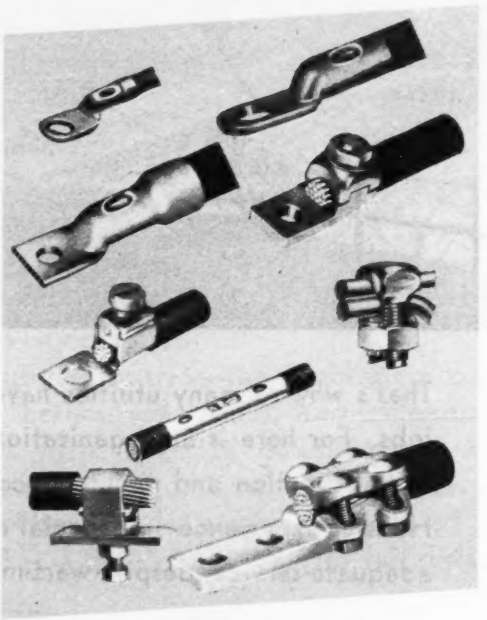

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By now you've probably heard a great deal about Bethlehem's simple new serving tool. How it makes possible a tremendously strong serve by means of the dead-end coil method; how it's so easy to use that any lineman can learn to handle it in a few minutes; how the serve can be made in about the time required to attach conventional clamps.

But there are other advantages, too, that are by no means incidental. Economy, for one thing. Bethlehem dead-end wire, used with the tool, costs only a few cents per 10-foot coil—considerably less than even a single inexpensive clamp. The savings mount accordingly where two or three clamps would be required.

And another thing: when linemen use the serving tool, there is no need to carry many items of different-sized clamps on field trucks or in store inventory. All you require is a supply of dead-end wire in 10-foot coils, each coil being enough for a complete serve of 50 turns on strand sizes up to and including 7/16 in.

The serving-tool technique is recommended primarily for use with bethanized strand and bethanized dead-end wire. Bethanizing simply means that a uniform, ductile, protective zinc coating is applied to every wire by an exclusive electrolytic process. The zinc coating is more than 99.9 per cent pure, and the years have amply demonstrated its effectiveness against corrosion.

Remember this trio—the Bethlehem serving tool, bethanized strand, and bethanized dead-end wire. Used in combination, they mean simplicity and economy—plus serves that hold beyond the useful strength of the strand. Ask a Bethlehem man for full details.

★ ★ ★ BETHLEHEM STEEL ★ ★ ★

NEWS ABOUT PEOPLE

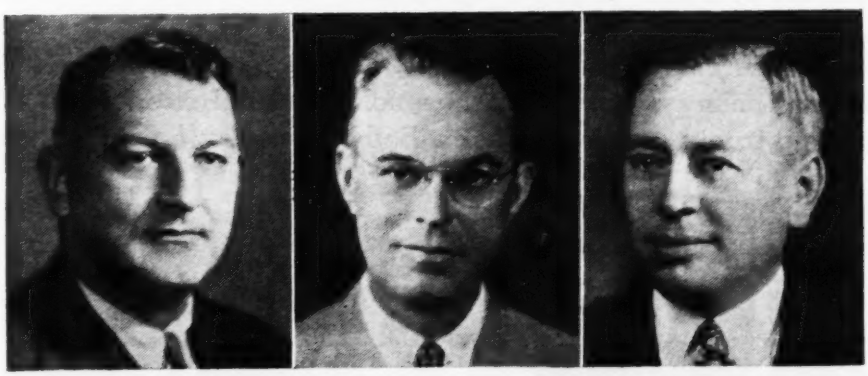
New England Power Executives Take Office

Thomas G. Dignan, whose return to the operating field after several years as president of the New England Power Service Co., Boston, was mentioned briefly in a recent issue of ELECTRICAL WORLD, was born at Wakefield, Mass. He received his bachelors' degrees from Holy Cross College and Boston University Law School, and in 1928 joined the corporate department of the New England Power Association at Boston, soon becoming assistant general counsel. From 1930 to 1932 he was manager of the Lowell (Mass.) Electric Light Corp., then being elected secretary of the Association. In 1934 he became vice-president and general manager of the then Worcester (Mass.) Electric Light Co., and in 1941 its president, becoming head of the Service company later that year. With headquarters at Malden, Mass., Mr. Dignan now heads the Malden, Lowell, Lawrence, Haverhill (Electric) Eastern Massachusetts Electric, Suburban (Revere), Arlington (Gas), Salem, Gloucester and Beverly companies of the New England Power System.

Edwin A. Dow, new president of the New England Power Service Co., Boston, is a native of Cranston, R. I., and a graduate of Brown University. In 1912 he was employed by the Power Construction Co. on the Shelburne Falls (Mass.) hydroelectric developments of the New England Power system. In 1916 he joined the Southern Power Co. in North Carolina, returning soon to his former New England company. In 1936 Mr. Dow became chief engineer of the Service company and in 1941 was named vice-president. He will continue as chief engineer in addition to his duties as president.

Arthur E. LaCroix, whose appointment as executive vice-president of the New England Power Service Co., Boston, was also noted in a recent issue of ELECTRICAL WORLD, is a native of Holyoke, Mass., and a graduate of Cornell University (1916). He entered the employ of the New England Power system in 1916 in connection with its hydroelectric developments on the Deerfield River in Massachusetts, and since then, with the exception of two years' service with the U. S. engineering forces in this country and overseas during World War I, has been intimately identified with the development of the System.

During recent years Mr. LaCroix has been occupied with negotiations, abitrations, court cases and discussions with state and federal bodies, including the development of the Pittsburgh reservoir, and later with the securing of FPC licenses for Bellows Falls and Vernon developments, and the supervision of preliminary investigations and engineering studies for the Wilder hydro redevelopment. In 1936 he was made assistant vice-president of the New England Power Association and in 1941 assumed the duties of vice-president of its three major wholesale companies.



T. G. Dignan | E. A. Dow | A. E. LaCroix

Consolidated Appoints Scofield Sales Manager

L. A. Scofield has been appointed general sales manager of Consolidated Edison Co., Brooklyn Edison Co. and New York and Queens Electric Light & Power Co. Mr. Scofield will be in charge of all sales activities in the companies under the direction of Nils T. Sellman, assistant vice-president. He was formerly general distribution manager for the three companies.

Mr. Scofield was first employed by the Consolidated Edison System in 1912 as an assistant tester in the test department of the New York Edison Co. He has held various engineering jobs, including that of power engineer in the sales department.

In 1943 he acted as consultant to Lieutenant General Somervell in the reorganization of the industrial personnel division of the Army Service Forces.

•

▶ CURTIS W. BOOTH, assistant superintendent of the Commonwealth Edison Co. meter department, Chicago, retired on January 1 after nearly 40 years of service. Mr. Booth started his utility career in 1905 as a meter tester, advancing through the ranks to head clerk in 1917. He was placed in charge of the meter inspection and reading division eight years later, becoming assistant superintendent of the meter department in 1934. ROBERT J. BUSHNELL, formerly supervising engineer of metering, succeeds Mr. Booth.

▶ CHARLES HESS, utilization manager of the Puget Sound Power & Light Co. in charge of sales activities, has resigned to become a partner in the Puget Sound Appliance Co. in Seattle. Mr. Hess started with the Seattle utility in 1924 as a merchandise salesman and advancing through the ranks became local

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manager, commercial and industrial representative, merchandise coordinator, dealers' sales supervisor, sales promotional manager and then utilization manager. His most recent accomplishment was the promotion of the Regional Dealers' sales meeting for the Northwest Electric Light and Power Association.

•

▶ WALTER I. KNAPP, formerly lighting design engineer of the Detroit Edison Co., has joined the staff of Grand Rapids Store Equipment Co. as chief illuminating engineer. Mr. Knapp is a member of the I. E. S.

•

J. P. Jollyman Retires from Pacific Gas Co.

Josiah P. Jollyman, chief of the division of hydroelectric and transmission engineering, Pacific Gas & Electric Co., San Francisco, retired from active duty

with the company as of January 1.

Mr. Jollyman is known nationally for his contributions in the field of hydroelectric and high-voltage transmission engineering, having designed some of the company's most outstanding stations. He worked out the details of operation of the first 110,000-volt transmission line in the West and under his directions were solved the perplexing problems of corona, stability and carrier communication on 220-kv. lines.

After being graduated from Stanford University in electrical engineering in June, 1903, Mr. Jollyman entered the employ of the California Gas & Electric Corp., later merged with P. G. & E. He served in various capacities in building hydro plants and substations until 1909, when he joined Great Western Power Co. In 1911, Mr. Jollyman returned to P. G. & E. as engineer of electric construction and in 1920 was given the title he held at the time of his retirement.

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Affiliated with Pyrene Manufacturing Company

Mr. Jollyman has been active in the affairs of the American Institute of Electrical Engineers, of which he is a fellow.

Although retired from active duty with the company, his services will be retained in an advisory capacity.

•

Phillips Retires From Long Island Lighting

Announcement has been made that Ellis L. Phillips has retired as chairman of the board and a director of the Long Island Lighting Co., having passed the normal retirement date of service with that utility system. He also retired from the respective boards of subsidiaries of Long Island Lighting.

Mr. Phillips' retirement brings to a close thirty-five years of service with the company since its incorporation in New York State in 1910. He is the last member of the original board of directors to retire from participation in the company's affairs.

•

▶ ELMER HANSEN has been appointed assistant superintendent of production of the Florida Power Corp., St. Petersburg, Fla. Mr. Hansen, who is a native of Portland, Me., goes to the Florida utility from Columbia, South America, where he was an electrical engineer with the Electric Bond & Share Co. for the past four years. Before his assignment in South America he had been with the Iowa Electric Light & Power Co. and the General Electric Co.

▶ DR. GANO DUNN, president of the J. G. White Engineering Corp. and president of Cooper Union, and DR. FRANK B. JEWETT, chairman of the National Defense Research Committee, who has just retired as vice-president of the American Telephone & Telepgraph Co., have been made honorary members of the New York Electrical Society, Inc. Both Dr. Dunn and Dr. Jewett, who are two of the most eminent men in the engineering profession in the United States and both of whom have international reputations, have been past-presidents of the American Institute of Electrical Engineers and past-presidents of the National Research Council.

▶ JAMES D. LYNETT, retired supervising chief inspector of the Department of Water Supply, Gas and Electricity of the City of New York, has been appointed superintendent of the Bureau of Electricity of the New York Board of Fire Underwriters. Mr. Lynett is president of the International Association of Electrical Inspectors, a member of the

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Sinclair RUST-O-LENE B for exposed metal surfaces of machinery in operation, in storage, or in transit

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Sinclair OPALINE RP (Rust Preventing) OILS for enclosed oil systems, prevent internal rusting of engines, hydraulic systems, gear reducers, and similar machinery intermittently operated, stored, or transported. OPALINE RP also has ample lubricating qualities for temporary use.

Both these remarkable Sinclair rust-preventives have successfully passed the most exacting service tests, and fully meet Government specifications.

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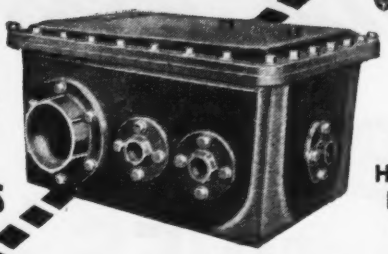

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This complete line of O.Z. Cast Iron Junction Boxes is enjoying an ever-increasing usage in the building of railways, subways, docks, bridges, industrial plants, highways and underground systems. Constructed of close-grain iron castings, these sturdy boxes are made with the same attention paid to quality and detail that has always been associated with O.Z. products.

Boxes are drilled to your specifications. Send for drilling template pads and also for catalog showing wide range of sizes along with complete data on Conduit Fittings . . . Cable Terminators . . . Solderless Connectors . . . Power Connectors . . . Grounding Devices. You'll get prompt and efficient service.

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REPRESENTATIVES IN PRINCIPAL CITIES

Electrical Council of the Underwriters' Laboratories, Inc., chairman of the electrical committee of the United States Conference of Mayors and a member of the electrical committee of the National Fire Protection Association.

•

► CLAY KUYKENDALL of San Saba, Tex., has been elected chairman of the board of the Lower Colorado River Authority, succeeding ROY FRY of Burnet.

•

Reliance Electric Names Helm Sales Manager

Edward E. Helm, since 1928 district sales manager in Philadelphia for the Reliance Electric & Engineering Co., Cleveland, has been appointed general sales manager of the company. Mr.

Helm, who has been with Reliance since his graduation from Pennsylvania State College in 1924, has managed both the Birmingham and Philadelphia territories and has been particularly active in application work in the steel, textile and paper industries in these territories. Kenneth S. Lord will succeed Mr. Helm as manager of the Philadelphia district.

P. G. McAusland, for the past two years comptroller of the company, has been elected treasurer.

Both the marine plant and plant No. 2 have been brought together as a self-contained marine division under Manager Karl H. Meyer. Mr. Meyer has been with Reliance since his graduation from Case School of Applied Science in 1926, and has been superintendent of the marine plant as well as works engineer at the main plant. W. H. Haber, with Reliance 11 years, has been made production manager of this division in which is now concentrated the long run manufacture of the smaller Reliance equipment.

Larger and more specialized equip-

HURRICANE WARNING!

Plan now for your emergency communications system—put RCA 2-way Radio on your trouble trucks, and in your stations, shops, offices

With hurricanes annually causing great damage in the U.S.A., what can you do to prepare for these emergencies?

One thing will help a lot, and that is to put RCA 2-way Radio on every one of your trouble-shooter trucks, and in your stations, shops and offices.

RCA 2-way radio will enable you to contact and direct instantly every key unit of your construction and repair forces—fixed or mobile—assure swift attention to emergencies everywhere in your territory, for efficient public protection and service.

Call in RCA emergency communications equipment specialists to help you lay out a well-planned emergency radio system for post-war installation. Remember—AM or FM, RCA makes both!

BUY MORE WAR BONDS

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RADIO CORPORATION OF AMERICA

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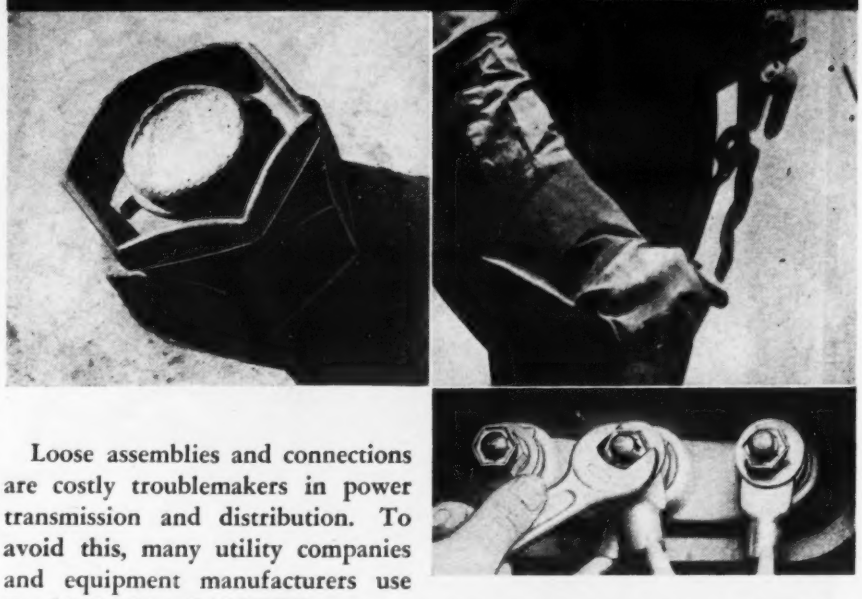
PALNUTS REDUCE MAINTENANCE COSTS!



Loose assemblies and connections are costly troublemakers in power transmission and distribution. To avoid this, many utility companies and equipment manufacturers use Double Locking PALNUTS to assure tight assemblies.

On structural assemblies such as steel towers and wood pole lines, PALNUTS prevent bolt and nut from loosening under vibration and shrinkage of parts—save further check-ups and re-tightening. On transformers, switches, disconnects, etc., PALNUTS keep terminals tight and assure perfect conductivity. Because they apply on top of regular nuts, PALNUTS are easy to remove and replace in field or shop. Can be added to present equipment without disturbing regular nuts.

Very low in cost, PALNUTS are available in all sizes, materials and finishes for every utility need. Write for engineering literature.

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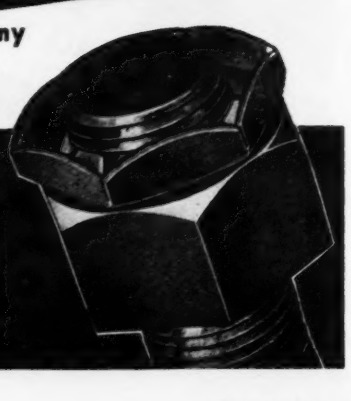

ment is produced at the main plant, now known as the Ivanhoe Division. Robert W. Cornell, who joined Reliance in 1930, has been appointed manager of this division.

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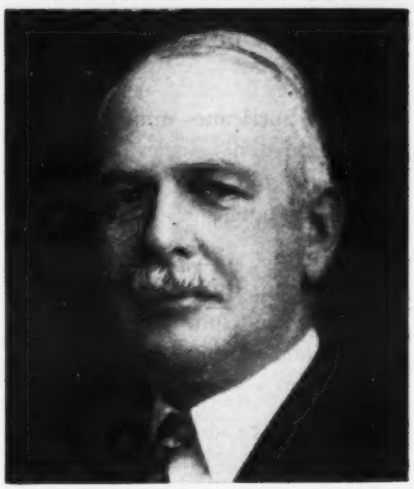
OBITUARY

C. W. Appleton

Charles W. Appleton, retired vice-president of General Electric Co., whose death was announced in the January 13 issue of ELECTRICAL WORLD, page 9, was born in Brockton, Mass., and was educated at St. Lawrence University. Admitted to the bar in 1899, he engaged



in the general practice of law for four years and in 1903 became assistant district attorney of New York City. In 1910 he was appointed city magistrate by Mayor William J. Gaynor.

Judge Appleton resigned from the bench in 1918 to become counsel to the General Electric Co., in which capacity he continued for nine years. During this time he was in charge of the company's defense in its investigation by the Federal Trade Commission under the Norris resolution and by the office of the Attorney-General. In 1937 he was elected a vice-president of the company in charge of general relations with public utilities, the position he held at the time of his retirement. Widely known throughout the electrical manufacturing and utility fields, he was in 1936 a member of the executive committee of the World Power Conference. As chairman of General Electric's New York Worlds Fair Committee he directed the preparation and operation of the company's extensive exhibit.

•

▶ BERT E. WALTZ, northern divisional manager of the Kentucky Utilities Co., with offices in Maysville, died on December 23 in that city in his seventieth

Georgia Power Company finds

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"A CITIZEN WHEREVER WE SERVE"

City	Customers
ATHENS	9,152
ATLANTA	107,016
AUGUSTA	17,852
BRUNSWICK	9,038
COLUMBUS	27,081
GAINESVILLE	5,592
MACON	19,711
ROME	11,663
Total	207,105

Georgia Families know from personal experience that the Georgia Power Company means what it says in the motto "A Citizen Wherever we Serve". Thousands and thousands, in their various contacts with this public utility, have come to know the smooth, efficient service that wins and retains friendships in every part of the community.

Many factors support this quality of service, and of major importance among them are Georgia Power's *Kardex Visible* Systems of Record Control in the eight cities shown above. Kardex Customer Service Records have made it possible to maintain improved service in spite of abnormal changes in customers and personnel.

Kardex expedites customer interview work by *centralizing* all needed data in quick-reference records. Accurate, complete information immediately provides clear, satisfactory answers. The Customer History Record also constitutes a highly valuable credit control improving ability to pass on credit accurately and quickly.

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SYSTEMS DIVISION

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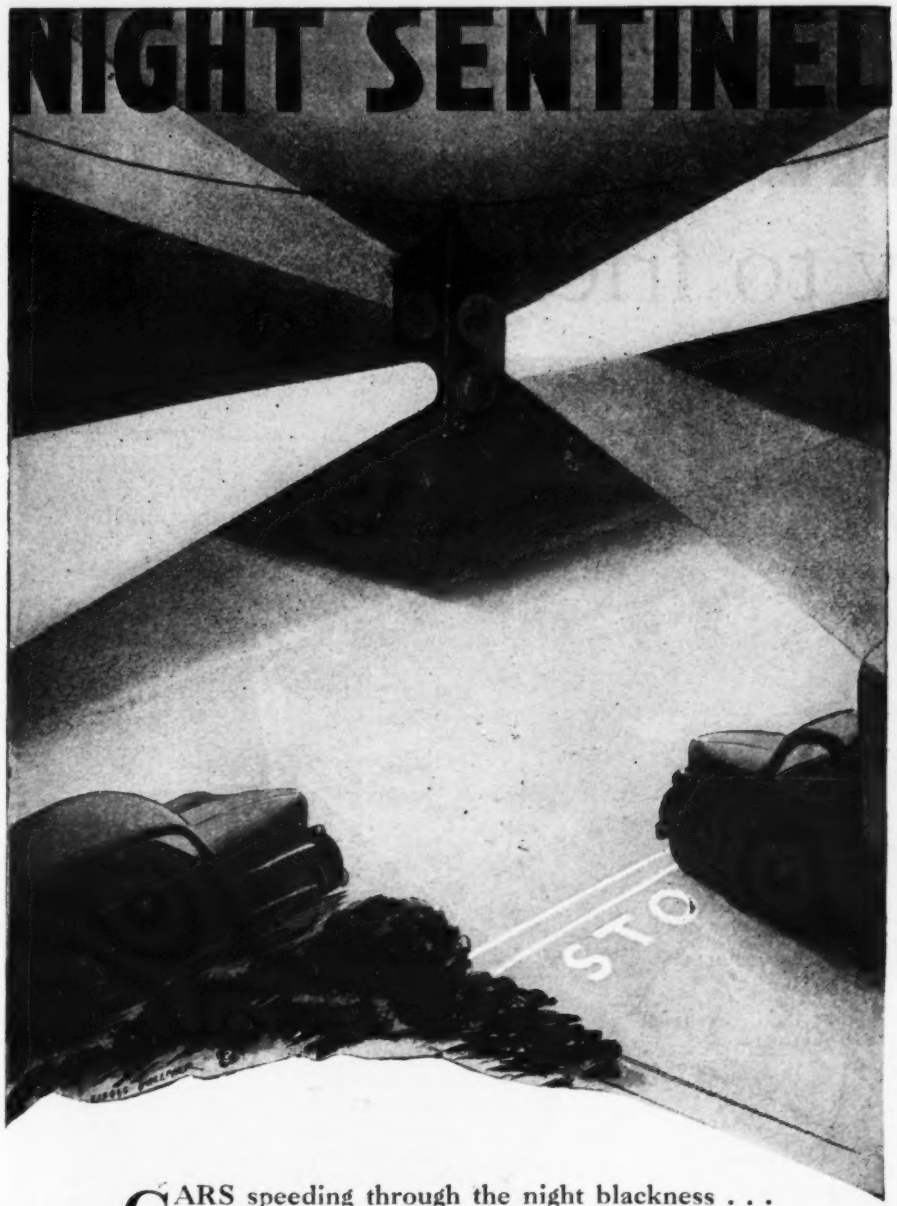

CARS speeding through the night blackness . . . crossroads where danger lurks . . . but motorists are warned and guided by the flashing beams of the traffic signal light. The lamps that light this sentinel of the highways must be dependable, enduring. For one lamp failure could cause serious accidents and fatalities. That is why every SLATER Traffic Lamp is built to give reliable performance during its entire lamp life.

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SLATER ELECTRIC & MFG. CO.

BROOKLYN, NEW YORK

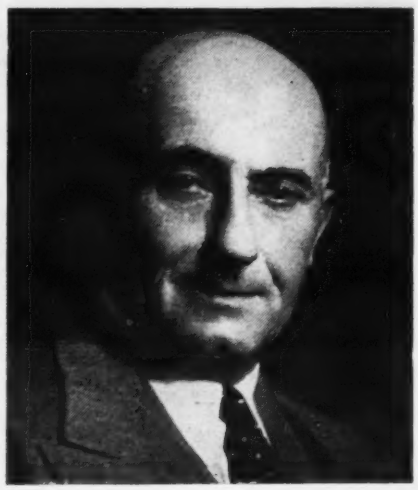
MANUFACTURERS OF STREET LIGHTING LAMPS, AND PRECISION ELECTRONIC TUBES

year. A native of Williamsport, Pa., Mr. Waltz went to Maysville in 1928 as district manager of the company and in 1935 was named northern divisional manager.

•

C. E. Houston

Clyde E. Houston, vice-president and general manager of the Southern California Edison Co., whose death was announced in the January 13 issue of ELECTRICAL WORLD, page 9, was born in Sparta, Ind., and had been identified



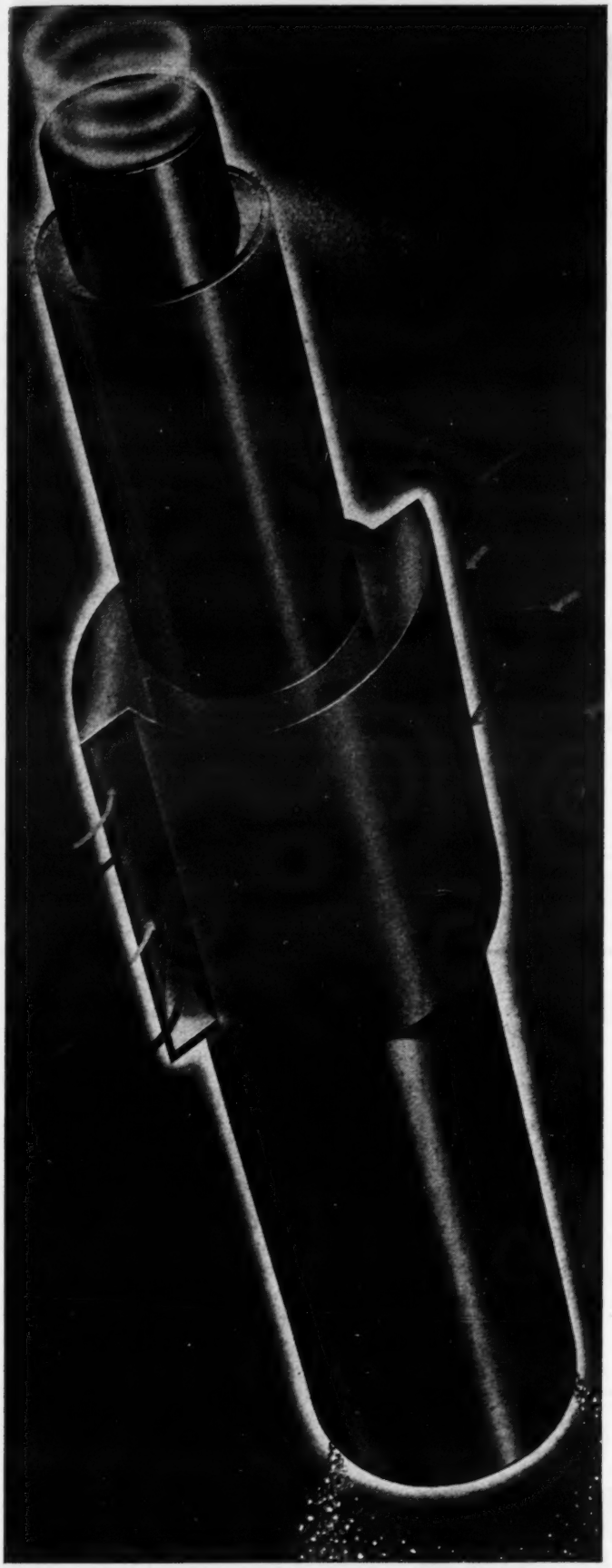
with the Edison and predecessor companies for forty years. He started in 1906 as superintendent of construction for the Ventura (Calif.) County Power Co., which brought under one head the several electric companies serving the cities of Ventura, Oxnard and Santa Paula and which later was merged with the Southern California Edison Co.

After holding various positions in many of the company's districts he was appointed manager of the eastern division, comprised of six districts, in 1930. Two years later he became assistant commercial manager in the general offices at Los Angeles. In 1936 he was named commercial manager and three years later assistant general manager. It was in 1940 that he was promoted to the office of vice-president and assistant general manager and then vice-president and general manager.

Mr. Houston was elected president of the Pacific Coast Electrical Association in 1940.

•

▶ LESTER B. WIEGERS, vice-president, secretary-treasurer and a member of the board of directors of Electric Bond & Share Co., died suddenly in Woodbridge, N. J., of a heart attack. He was stricken while on the way to his office. Mr. Wiegers was 42 years of age. Mr. Wiegers joined the company as a member of the accounting department in



THE TUBE THAT MADE

MECHANICAL-ELECTROSTATIC

DUST COLLECTION POSSIBLE

THE Duplex Dust Collector is like a double-barreled shotgun! "Why?"

Because it takes two barrels to get real results—the second barrel hits what the first one misses.

That, briefly, is the story of the new Thermix Duplex Collector. It combines *both* mechanical and electrostatic principles but its size is only slightly larger than the conventional mechanical units. And it *gets* results—94.66% *total* dust elimination, as proved by actual tests on extremely fine pulverized fuel dust! Dust escaping from this collector need never worry you even if dust ordinances and health requirements become increasingly severe. It solves your problem—economically—once and for all.

If desired, only the mechanical section of the Thermix-Duplex need be installed at the outset. Should greater efficiency be required, the secondary section can be added at any time. Furthermore, the Duplex is so designed that the mechanical unit *alone* will give high dust collection while the circuit of the electrostatic unit is being cleaned.

Write for bulletin giving engineering data.

•

THERMIX ENGINEERING COMPANY

Project and Sales Engineers

FIRST NATIONAL BANK BLDG., GREENWICH, CONN.

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.

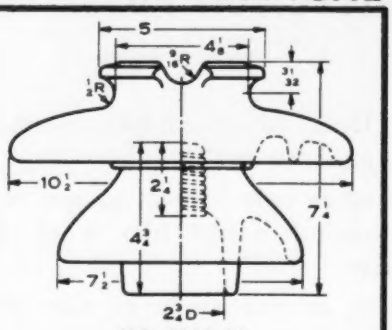
THOMAS

Porcelain Insulators and Line Hardware

Here are a few items from our complete line of Porcelain Insulators and Line Hardware selected by Engineers for 33 Kv. construction.

For complete engineering details and a copy of our latest Catalog No. 40—mail the coupon below.

TYPICAL DESIGNS



NO. 2124-M

45 Kv. Rating

Dry Flashover	125 Kv.
Wet Flashover	85 Kv.
Rec. Pin Height	8 In.
Std. Pkg. Crate	6

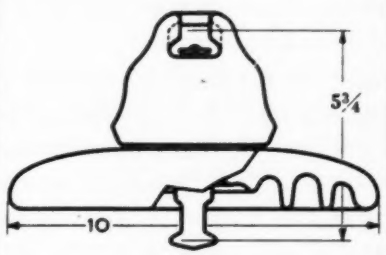
This insulator generally used on 33 Kv. can also be furnished in one-piece design (No. 1924). Mechanical, thermal and electrical characteristics are well balanced insuring long life in service.

NO. 9716 SERIES

Tapered Body Style for Wood or Metal Arm

Height Above Arm	6 to 13 In.
Below Arm	1¾ or 7 In.

Pins are a solid forging of special high carbon steel. Tapered design allows uniform strength in all directions with full strength carried to top.

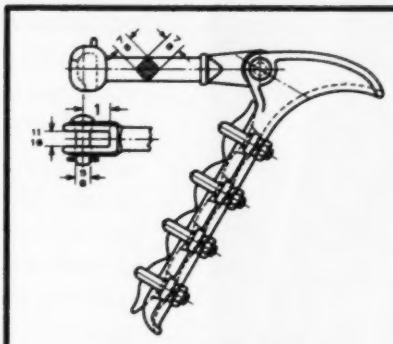


NO. 21243

15,000 Lb. Min. Combined M. & E. Rating

Dry Flashover	80 Kv.
Wet Flashover	50 Kv.
Leakage Distance	11½ In.
Std. Pkg. Crate	6

This design is offered in a wide range of spacings in both Ball-Socket and Clevis types which fulfill all strain insulator requirements.



NO. 5000 SERIES

S. A. E. 1035 Copper Bearing Steel, Galvanized

Min. Cable Sizes	.187 to .82 In.
Max. Cable Sizes	.55 to 1.28 In.
Ultimate Strengths,	25,000 - 35,000 Lbs.

Offered for all sizes of A. C. S. R., copper and composite conductors, light in weight but with mechanical and slip strength adequate for the most severe service.

THE R. THOMAS & SONS CO.
Lisbon, Ohio

Please send me your Catalog No. 40 illustrating Porcelain Insulators and Line Hardware for Distribution Lines.

Name ..... Title .....

Address .....

City and State .....

THE R. THOMAS & SONS CO.
LISBON, OHIO
New York · Boston · Chicago

1925. Prior to that time, he was with Marwick, Mitchell & Co., certified public accountants. In 1935 he was appointed assistant secretary and assistant treasurer of Bond & Share and five years later became secretary-treasurer and a director. Last November Mr. Wiegers was appointed a vice-president retaining his duties as secretary-treasurer and continuing as a member of the board of directors. He was particularly active in the company's program of conformance with the Holding Company Act of 1935. This work frequently took him to Philadelphia where he appeared in many proceedings before the Securities and Exchange Commission as a company representative.

•

▶ Robert S. McCarty, advertising manager of the Philadelphia Co. and subsidiary companies of Pittsburgh, Pa., died on December 31 at his home in that city after a long illness. A native of Uniontown, Pa., and a graduate of the University of Pittsburgh, Mr. McCarty entered the employ of the Philadelphia Co. in 1921 in the engineering department, later becoming engaged in public relations work for the company. He became advertising manager in 1925. He was a past-president of the Public Utilities Advertising Association and the Pittsburgh Advertising Club, and held membership in the Pennsylvania Electric Association, Electric League of Western Pennsylvania and the Pittsburgh and Pennsylvania State Chamber of Commerce.

▶ Browder J. Thompson, associate research director of the Radio Corp. of America laboratories in Princeton, N. J., and consultant in the office of the Secretary of War, since December, 1943, was killed during a flight in an Army plane in the Mediterranean area on July 4, according to a War Department announcement. He was 40 years of age. Since 1926 Mr. Thompson had done research and development work on electron tubes for industrial application as well as directing work in the field of television tubes. He was recognized as one of the nation's foremost radio research specialists. Early in his career he was connected with the research laboratory of the General Electric Co. at Schenectady.

▶ Henry K. Morrison, 79, former manager of the Concord (N. H.) Electric Co. and later of the Lynn (Mass.) Gas & Electric Co., died at Cambridge, Mass., on January 10. He was graduated from Stevens Institute of Technology in 1886. Mr. Morrison retired in 1926.

IN THE FIELD OF RADIO NOISE ELIMINATION TOBE IS THE ACKNOWLEDGED LEADER

AWAY AHEAD!

ONE engineering result of the war is increased knowledge of radio interference problems. It will never be lightly treated again. No engineer can tackle the development of an electrical design without giving due consideration to minimizing the radio interference it creates in operation. Specially designed filters, to be built into electrical circuits, can usually solve the problem of radio interference.

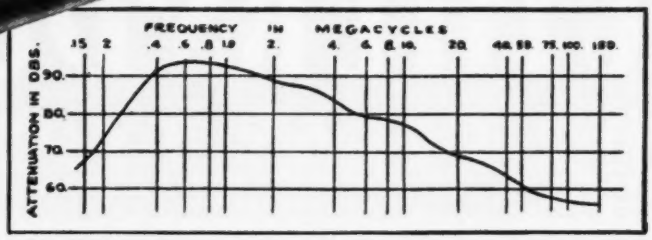
Here at Tobe is a great storehouse of knowledge in this subject. It is *sound* knowledge, gained by the most intense interest and experience of any company in the field.

Tobe Filterizing is a copyright term. It means that Tobe knows how to "filterize" man-made radio noise. Why not make use of this valuable 16 years' of experience in your own engineering? Place your reliance on Tobe and the famous Tobe Filterettes. Send us your problems now.

TOBE DEUTSCHMANN CORPORATION • CANTON, MASS.

CONTAINER DIMENSIONS

Length .....4 7/16"
Width .....2⅛"
Height .....2⅞"
Overall length..6¼"



SUPPRESS MAN-MADE RADIO STATIC
TOBE
FILTERIZED

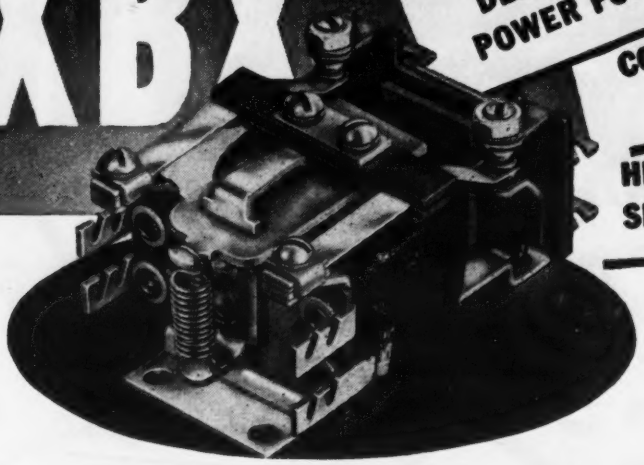
A SMALL PART IN VICTORY TODAY — A BIG PART IN INDUSTRY TOMORROW

10XBX

DELIVERS A LOT OF POWER FOR ITS SIZE

COVERS A WIDE RANGE OF APPLICATIONS

HIGHLY RESISTANT TO SHOCK AND VIBRATION



. . . A GOOD RELAY TO KNOW!

If any Relay type ever deserved the name "All-Purpose" it is Type 10XBX of the Struthers-Dunn 10-frame series. While new and special types come and go, this popular 2P. D.T. relay continues in heavy favor with leading users to whom its extreme versatility on a wide range of applications holds strong appeal. From audio frequency circuits to motor control circuits; from naval battle announcing stations where shock resistance is important, to aircraft use where vibration is a big factor, 10XBX relays are performing competently and well.

These relays are light, small, and sturdy. Highly electrically efficient, they deliver a lot of power for their size. Contact pressures up to 50 grams are available. Bakelite insulation is supplied for power circuit applications, and ceramic insulation for radio-frequency use. A-C coils to 115v, 60 cycles; or d-c coils to 115v are available. Contacts may be in any desired combination up to and including 3 pole, double throw. All 10XBX relays withstand 10G vibration and are highly resistant to shock. Other relays of the 10-frame series are available in either single or three pole contact arrangements.

STRUTHERS-DUNN, Inc., 1321 ARCH ST., PHILADELPHIA 7, PA.

WRITE *for the big Struthers-Dunn 48-page Catalog and Relay Engineering Data Book.*

STRUTHERS-DUNN

5,312 RELAY TYPES

DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DALLAS • DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO • WASHINGTON

PREVIEW OF *Tomorrow's* PERMAFLECTOR FLUORESCENT LUMINAIRES . . . *Today!*

Stimulating beauty added to fluorescent efficiency . . . *and engineered for ease of installation and maintenance*

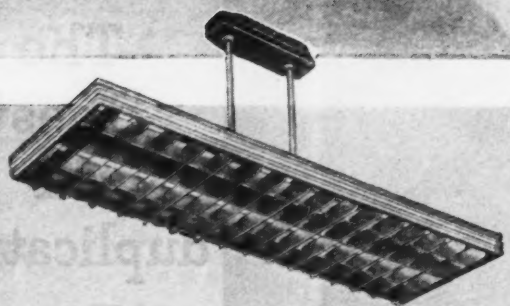
In addition to constant production of vital war material, Pittsburgh Reflector Company has continued the improvement and expansion of its standard products. Now, these new, more beautiful and more effective Permaflector *Fluorescent* Luminaires are ready!

Designed to be beautiful, *engineered* to be practical, they combine ease of installation and maintenance with maximum illumination efficiency. Thirty-two years of experience making better commercial lighting fixtures, plus new skills and facilities acquired in wartime manufacturing, assure you of the "ultimate" in Fluorescent perfection when you specify Permaflector Fluorescent Luminaires.

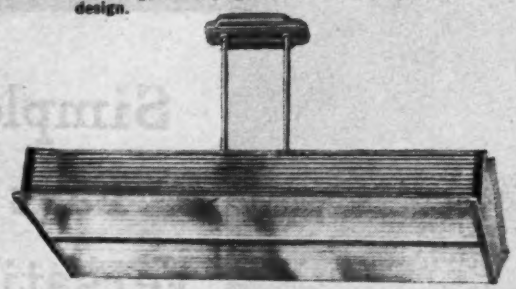
Write for full information.

Incandescent or fluorescent . . . *which?*

Neither Incandescent nor Fluorescent lighting, individually, is a cure-all for every illumination problem. Always consult your Permaflector engineer to secure the right type, or combination, for each application. Pittsburgh Reflector Company manufactures both types and can give you unbiased recommendations.



Startlingly new all aluminum, shielded type, 4-40 watt Luminaire for individual or continuous mounting, embodying drastic new principles of design.



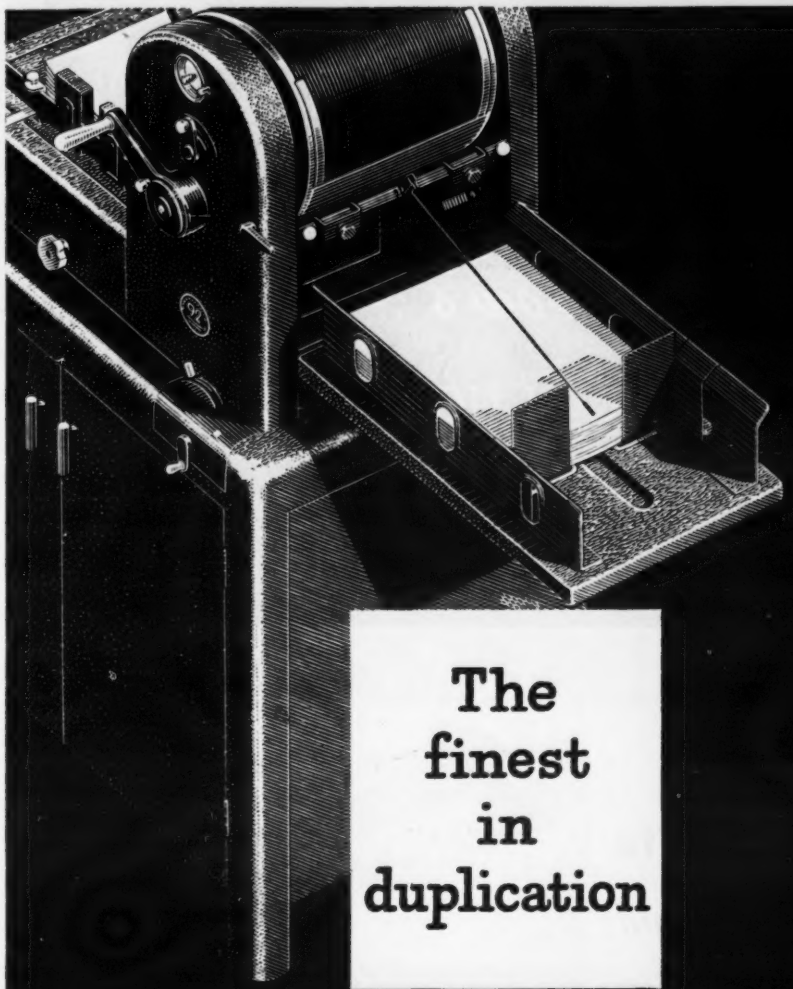
A scintillating glass, shielded type, 4-40 watt Luminaire for individual or continuous surface or suspension mounting. Light is controlled; maintenance easy.

A 2-lamp shielded unit for individual or continuous surface mounting—it's different from anything you have seen.

Pittsburgh REFLECTOR COMPANY

OLIVER BUILDING · PITTSBURGH, PA.

Manufacturers of Permaflector Lighting Equipment



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Results You're Proud Of

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CROCKER-WHEELER MOTORS for ALL INDUSTRY

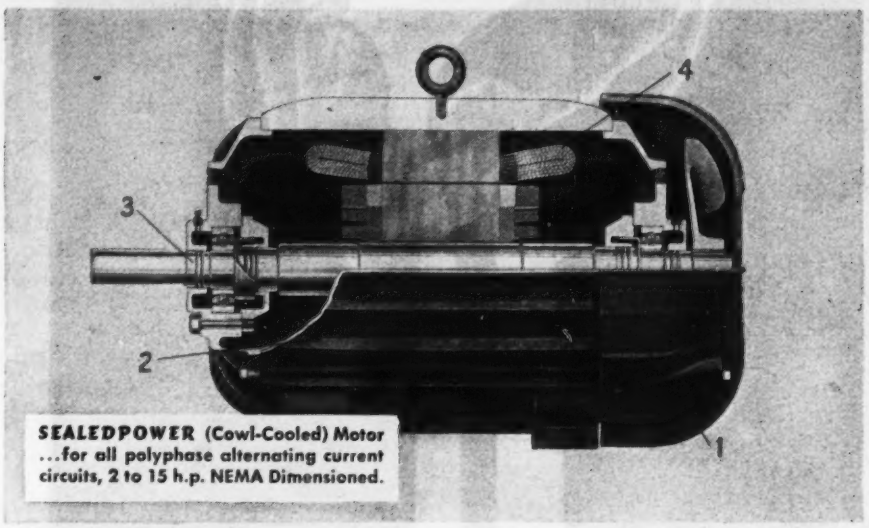
FEATURES

1. Totally Enclosed Cowl-Cooled type minimizes fire hazard, resists corrosion. Protects against acid or alkali fumes, splashing or dripping corrosive liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, lint, etc.

2. Fin Type single shell construction, with all surfaces exposed and a readily removable fan shroud, gives non-clog ventilation. Easy to clean...foreign matter passes over the surfaces of and not through the motor.

3. Patented GROOVSEAL antifriction bearings—no greasing needed for at least a year—minimizes maintenance. Seal permits use of softer grease, for better lubrication and longer bearing life. Water-tight—Dust-tight—Air-tight.

4. Vacuum Impregnation with high grade insulating varnish seals out foreign matter and moisture from each individual coil...makes windings a homogenous mass...reduces hot-spot temperature and lengthens insulation life. Adherence of varnish prevents vibration of wires inside or outside of slot.



SEALEDPOWER (Cowl-Cooled) Motor ...for all polyphase alternating current circuits, 2 to 15 h.p. NEMA Dimensioned.

SEALEDPOWER ...Industry's Most Trouble-Free Motor

because...

YOU CAN DEPEND on a Crocker-Wheeler field engineer to recommend the power equipment *you need.* Behind him is *56 years* of our company's experience...*56 years* of continuously developing facilities and skills *exclusively* in the power field.

Crocker-Wheeler, one of the leading companies in the field, specializes SOLELY in the design manufacture and application of electric power equipment.

As power SPECIALISTS, Crocker-Wheeler field engineers know the power needs of your industry—of your particular production processes. Call in one of our experienced engineers for specific advice on motors, generators, control and couplings... no obligation.

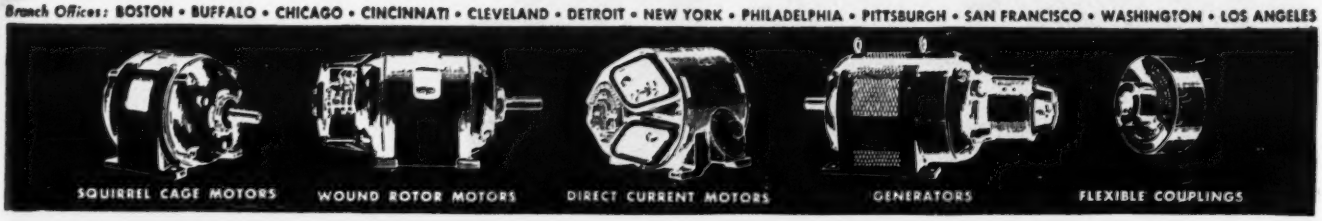
JOSHUA HENDY IRON WORKS

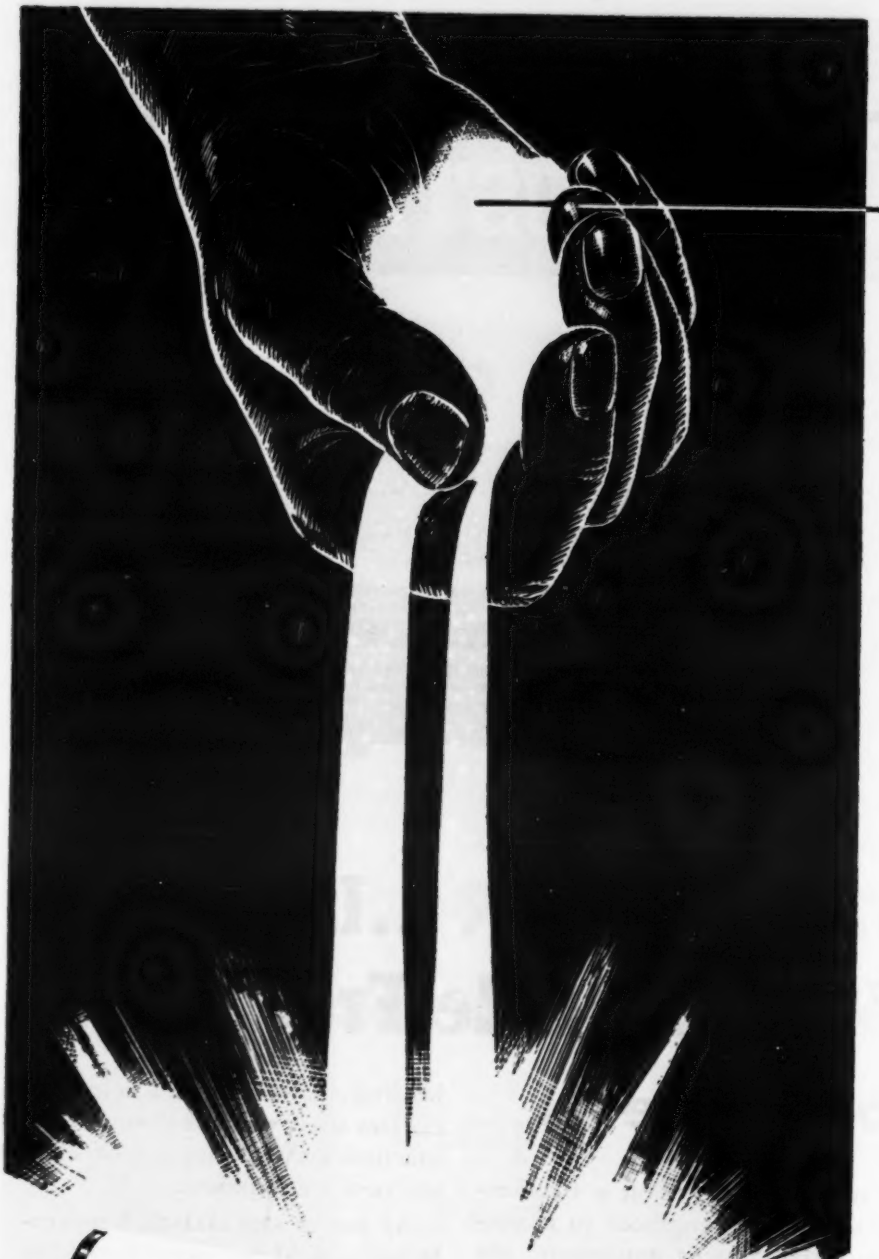
CROCKER-WHEELER DIVISION

ESTABLISHED 1856

AMPERE, NEW JERSEY

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON • LOS ANGELES





THE MORE

THE MORE

B-R-I-G-H-T
FROM END TO END

SPARKLE IN THE POWDER . . .

The greater the care in selection and compounding of phosphor powders for fluorescent lamps, the greater the brightness from the lamp, and the more See-ability the lamp produces in service.

Westinghouse research engineers found, for example, that foreign substances in a batch —*just one part in a million*—make an appreciable difference in light output.

To eliminate these impurities, Westinghouse research has devised new and effective purification processes. A carefully planned and meticulously controlled routine of acid washing, high-temperature firing, grinding, mixing and blending, assures maximum purity and brightness performance in the finished phosphor.

To give your customers better See-ability, recommend bright, long-lasting Westinghouse Mazda Lamps for every lighting application and installation. Westinghouse Electric & Manufacturing Company, Bloomfield, New Jersey.

SEE-ABILITY FROM THE LAMP

THE MORE

THE MORE

B-R-I-G-H-T
FROM END TO END

SPARKLE IN THE POWDER . . .

The greater the care in selection and compounding of phosphor powders for fluorescent lamps, the greater the brightness from the lamp, and the more See-ability the lamp produces in service.

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To give your customers better See-ability, recommend bright, long-lasting Westinghouse Mazda Lamps for every lighting application and installation. Westinghouse Electric & Manufacturing Company, Bloomfield, New Jersey.

SEE-ABILITY FROM THE LAMP

Fuel for the Fires of Freedom

Over miles of prairies . . .

Over hills and under rivers . . .

Through compressor stations, run America's pipelines, carrying fuel for industry, commerce and American homes.

Today, through a vast and busy network of pipelines and compressors, the natural gas industry is supplying fuel for the fires of America's freedom. Essential fuel is distributed to the homes of our people. Fuel in the greatest quantities in history is going to our industries—backbone of our war effort. Natural gas finds myriad uses, from the production of our arms to the manufacture of explosives and the creation, through chemistry, of new healing agents.

Many millions of cubic feet of natural gas from the Appalachian area and from the extensive fields of Texas are distributed by the Columbia System to more than 1,600 communities, with population in excess of 5,000,000.

Columbia's responsibility is to the public—the public it serves and the public by which it is owned; more than 82,000 shareholders living in every state and territory and many foreign countries.

COLUMBIA GAS & ELECTRIC CORPORATION

COLUMBIA SYSTEM

Seyler

MANUFACTURING COMPANY

Sharpsburg, P.O.

PITTSBURGH, PA., P.O. BOX 7227

Jan. 20, 1945

Transmission and
Distribution Engineers,

Gentlemen:

Everything points to 1945 being a most active year in the industry. A glance at the statistics reveal the largest maintenance and new construction budget since 1941 and '42.

Here is the Seyler five point program for 1945:

1. Seyler will produce more pole line hardware to meet increasing demands of the Army Signal Corps.

2. Seyler will continue to cooperate with the industry in supplying your essential needs.

3. Seyler is reorganizing and retraining its sales engineers to be ready to work with you on post-war construction plants.

4. Seyler's engineering department is continuing its development work to provide new and better hardware to meet your needs.

5. Seyler's uninterrupted production of pole line hardware assures you of an adequate and experienced source of supply at whatever time you call upon us.

J.B.W. Note this

Throughout 1945 Seyler will continue to carry the load for both military and industry needs. We want you to feel free to consult us on any of your line construction problems.

Sincerely yours,

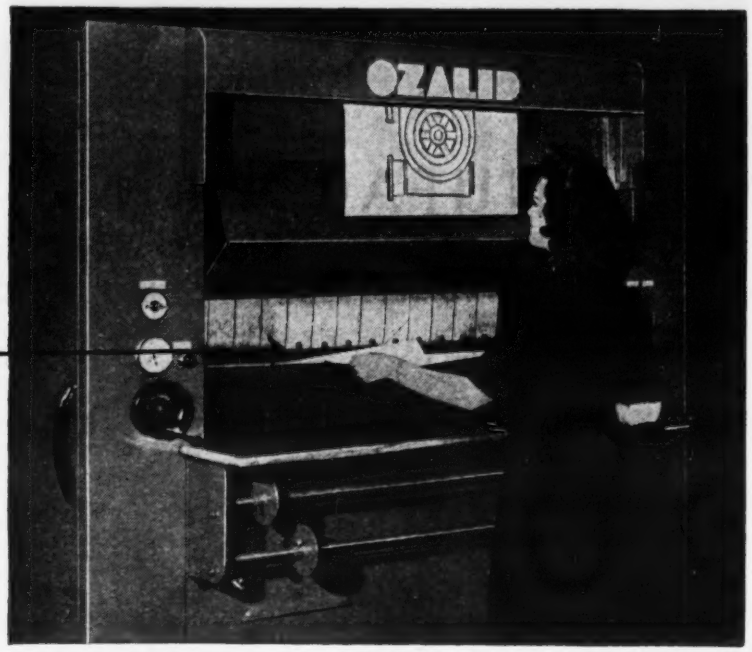
Carl Seyler

Carl Seyler

J.B.W. Do we have this

P. S. The Seyler up-to-date handbook and catalog No. 43 is yours for the asking.

Could be ALMOST ANYTHING



NYTHING DRAWN, TYPED, PRINTED, OR PHOTO-RAPHED ON TRANSLUCENT MATERIAL CAN BE REPRODUCED IN SECONDS WITH OZALID

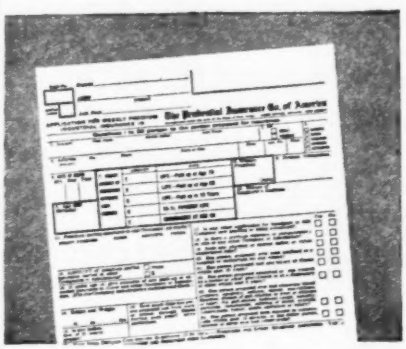
OU MAY HAVE wondered, if you haven't a drafting room, just how ou could use Ozalid . . . and whether or ot it would pay.

Right now, you can make exact repro-uctions—not negatives, direct from re-orts, forms, and letters you receive.

More often, of course, you will be re-roducing your own records, financial statements, sales bulletins, and instruction manuals.

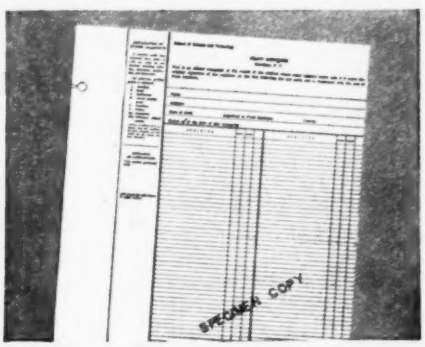
Besides, you are bound to think of individualized applications—unique ways in which you can use Ozalid's black, blue, red, and sepia line prints . . . also Ozalid foils, and the NEW DRYPHOTO papers which give you beautiful reproductions, complete with half-tone detail, from photographic film positives or perspective drawings.

You'll appreciate this versatility . . . which is found only with Ozalid. Also the convenience of being able to make these prints in seconds—whenever you want them, with an economical Ozalid machine designed for your production requirements.



t the Prudential Insurance Com-any, Newark, New Jersey, applica-ons for industrial insurance are repro-uced with Ozalid. The originals are kept n file and Ozalid prints are attached to ie policies. Prudential changed their orm, adopting a translucent sheet with rinting on only one side, so that they ould utilize OZALID.

At Alpha Music, New York City, music arrangements, drawn in ink, are reproduced with Ozalid. Performers on such radio programs as Coca-Cola's "Pause That Refreshes," Evening in Paris's "Here's to Romance," or any of the CBS shows from New York, are reading from easy-to-follow Ozalid Prints. Ozalid Dry Photos are also made.



At Pratt Institute, Brooklyn, New York, student records are kept on translucent paper and reproduced with Ozalid—whenever the need arises. Grades are added periodically to the master copy, averages and credits are computed, and the student receives an Ozalid print showing his latest standing. Retyping errors are eliminated.

LEARN MORE ABOUT USING OZALID ...AND SEE ALL THE OZALID PRINTS

OZALID

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OZALID IN CANADA—HUGHES-OWENS CO., LTD., MONTREAL

HIGH-ALTITUDE BRUSHES...

First aid for difficult ground-level applications

Many months have now passed since Stackpol brushes treated with a Westinghouse process fir made aircraft generator brush life at high altitud a matter of weeks and months instead of simp hours. During this time, much has been accon plished in adapting these same outstanding higl altitude brush principles to difficult and unusu ground-level applications.

The basic feature of these brushes is of cour their amazing ability to maintain the essential pr tective film on commutators in order to minimi wear under a wide variety of commutating co ditions. Although Stackpole research in applyin this feature to brushes for earth-surface equipment still continuing, it has now reached a point whe Stackpole engineers will welcome inquiries fro brush users having unusually difficult conditions t meet. You can count on a frank and honest opinio as to whether or not we believe Stackpole Higl Altitude Brushes can help you.

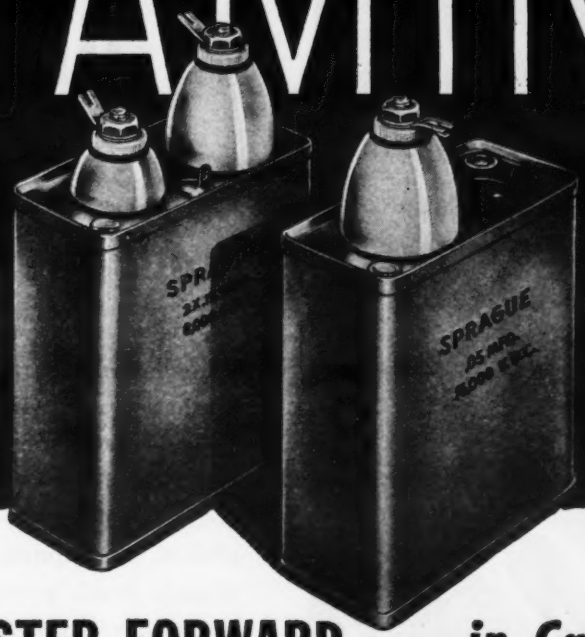
STACKPOLE CARBON CO., St. Marys, Pa

STACKPOLE

THE NATION'S LARGEST PRODUCER OF FRACTIONAL HORSEPOWER MOTOR BRUSHE

Brushes and Contacts (All carbon, graphite, metal and composition types *Rare Metal Contacts • Graphite Bearings • Welding Carbon Produc Packing, Piston and Seal Rings • Continuously Adjustable Carbon Rheosta Sintered Iron Components*

SPRAGUE VITAMIN-Q*



A BIG STEP FORWARD . . . . *in Capacitors for High Temperature, High Voltage Applications*

Vitamin Q impregnant, pioneered and perfected by Sprague, has resulted in capacitor developments of far-reaching importance for high temperature, high voltage applications. Although extremely compact, Sprague Type 25P Capacitors, for instance, operate satisfactorily at thousands of volts *at ambient temperatures as high as 105° C.* Moreover, their leakage resistance at room temperature is *20,000 megohms X microfarads*—or at least five times higher than that of previous types.

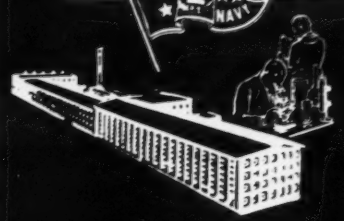
Sprague Vitamin Q impregnated Capacitors retain all of the virtues of conventional oil-impregnated capacitors throughout the extreme range of + 105° C. to —40° C. Used where high temperature is not a factor, they result in materially higher ratings for a given size.

Standard types include hermetically sealed rectangular metal container units in styles for 95° C. and 105° C. continuous operation, and in d-c rated voltages from 1000 to 16000 V. Other types include Type 45P hermetically sealed in glass shells with metal end caps.

SPRAGUE ELECTRIC COMPANY, North Adams, Mass.

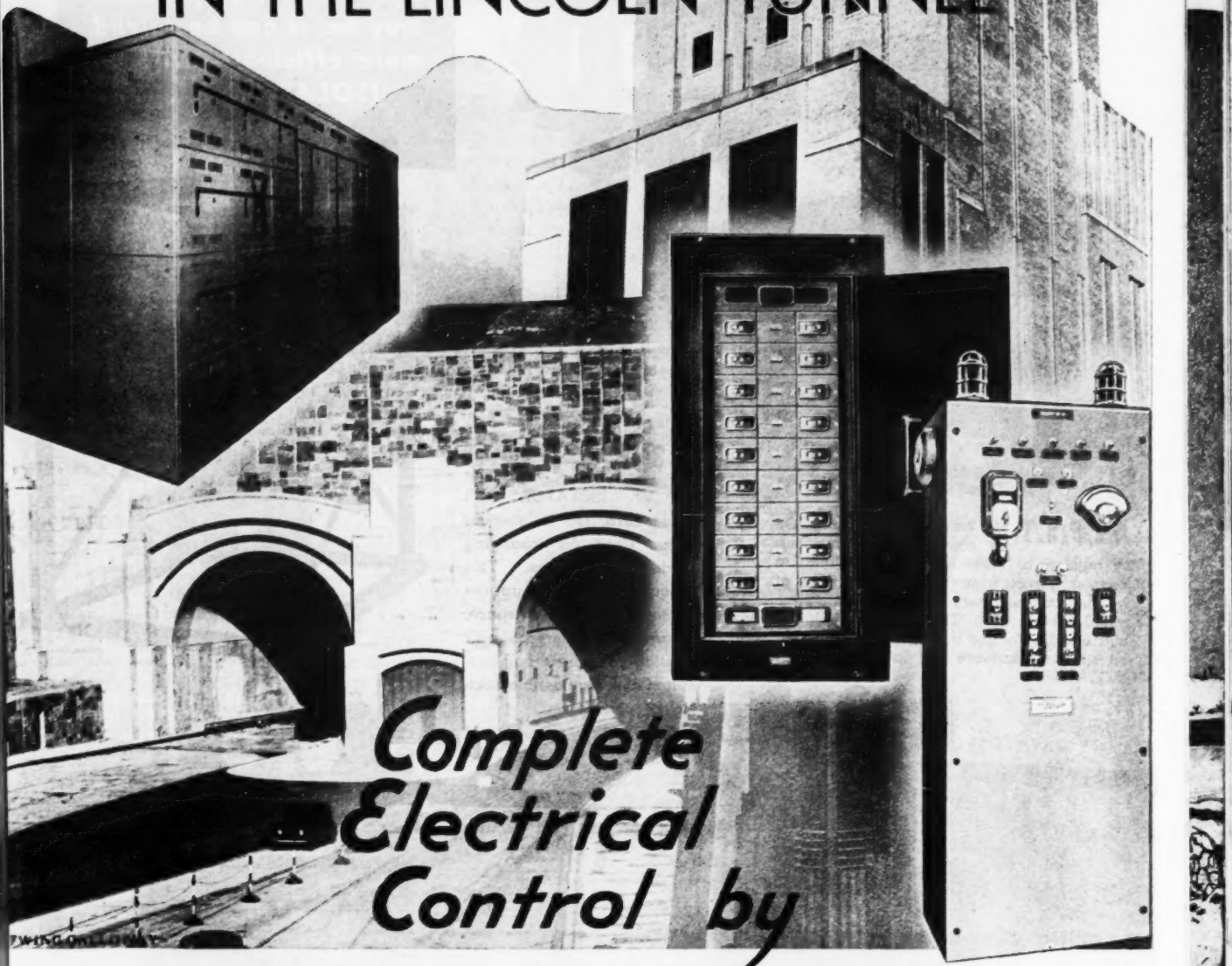
(Formerly Sprague Specialties Co.)

*TRADEMARK REG. U. S. PAT. OFF.



SPRAGUE CAPACITORS KOOLOHM RESISTORS

3 of the 18 METROPOLITAN ELECTRICAL UNITS IN THE LINCOLN TUNNEL



Complete Electrical Control by

At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

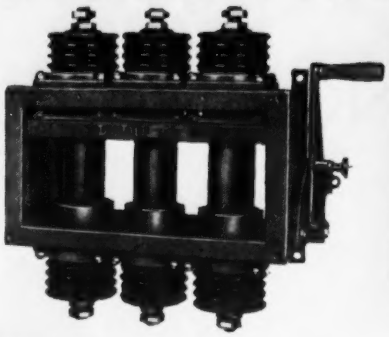
Knife Switchboards
Circuit Breaker Switchboards
Dead Front Switchboards
Battery Charging Switchboards
Motor Control Switchboards
Explosion-proof Switchboards
Laboratory and Test Switchboards
Control Switchboards
Generator and Distribution Switchboards

METROPOLITAN ELECTRIC MFG. CO.

ESTABLISHED 1892
METROPOLITAN
TRADE MARK
ELECTRIC LIGHTING AND POWER DISTRIBUTION EQUIPMENT

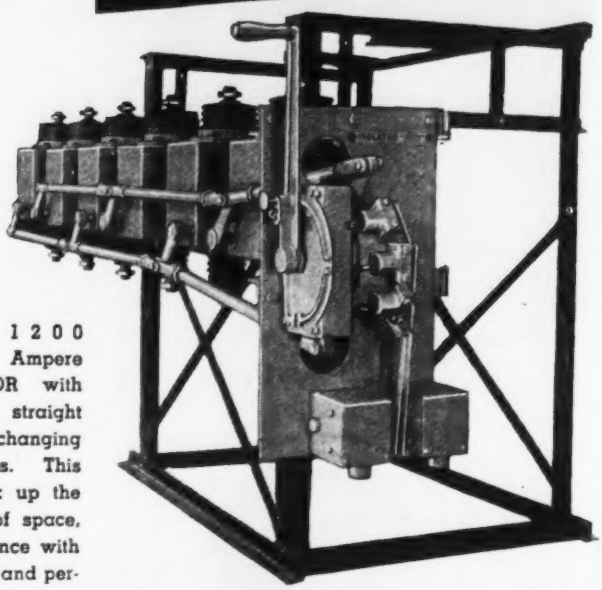
GENERAL OFFICES: LONG ISLAND CITY, N. Y. FACTORIES: LONG ISLAND CITY, N. Y., & WEST WARREN, MASS.

YOU CAN DO IT *Better* WITH AN ISOLATOR

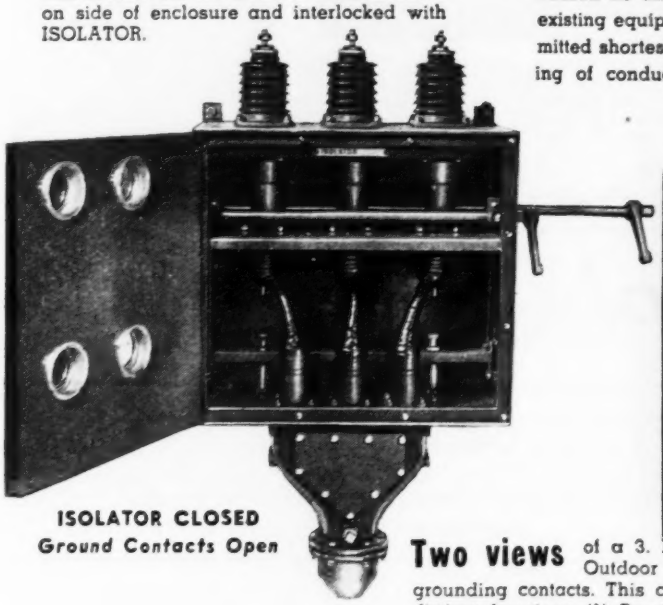


Whatever your high voltage switching problem may be, it can be solved more efficiently with an ISOLATOR . . .

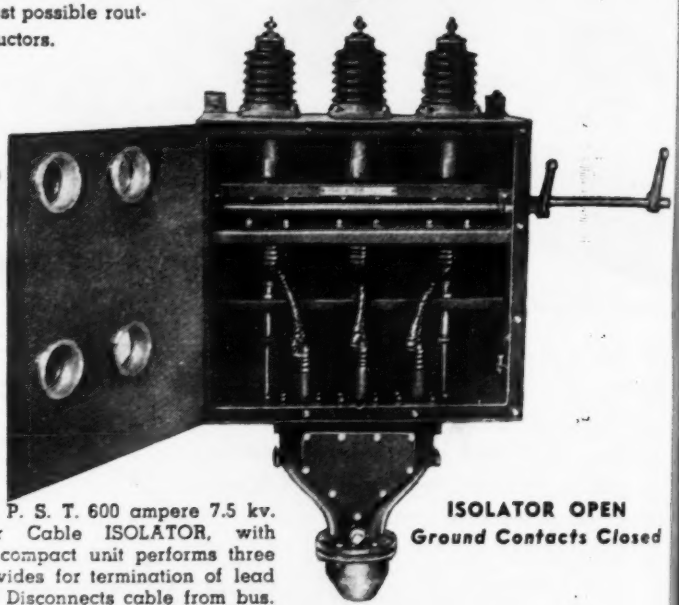
A 2.P.S.T. 200 ampere 5 kv. ISOLATOR in combination with fuses. A number of these devices were built to connect direct from bus duct to case of lighting transformers making a complete metal enclosed job. The secondary air circuit breaker for the transformer is mounted on side of enclosure and interlocked with ISOLATOR.



A 3. P. D. T. 1200 Ampere 7.5 kv. ISOLATOR with poles arranged in straight lines. Used for changing feeder connections. This unique design took up the minimum amount of space, caused no interference with existing equipment, and permitted shortest possible routing of conductors.



ISOLATOR CLOSED
Ground Contacts Open



ISOLATOR OPEN
Ground Contacts Closed

Two views of a 3. P. S. T. 600 ampere 7.5 kv. Outdoor Cable ISOLATOR, with grounding contacts. This compact unit performs three distinct functions. (1) Provides for termination of lead covered power cable. (2) Disconnects cable from bus. (3) Solidly grounds cable. It's interlocked to prevent faulty operation.

Because of its singular telescoping of contacts inside insulation ONLY THE ISOLATOR can solve vexing switching problems requiring saving of space, materials, installation labor, and still provide a greater margin of safety.

Ask for Bulletin 135 or consult our nearest representative.

THREE — ELECTRICAL ENGINEERS EQUIPMENT CO. — MELROSE PARK, ILLINOIS

MANUFACTURING MARKETS

Electric Firm Bound by Fair Labor Act

The Fourth United States Circuit Court of Appeals has ruled that Federal Judge William C. Coleman of the Maryland District Court erred in refusing to issue an injunction against the Roland Electric Co. restraining the company from refusing to comply with the Fair Labor Standards Act.

The case against the company involved the question of whether employees of a company which repairs and installs generators and electric motors for firms engaged in interstate commerce are, themselves, engaged in interstate commerce.

"There are two questions in the case," the appellate court stated. "One, whether the company's employees are engaged in the production of goods for commerce within the meaning of the act and, two, whether the company is a retail or service establishment, the greater part of whose selling or servicing is in intrastate commerce.

"No one would contend, we think, that employees who did for the customers of the company what its employees did here would not have been engaged in the production of goods for commerce if they had been employed by the customers; but the fact that they were employed by an independent contractor makes no difference, since the application of the act depends not upon the nature of the employer's business but upon the character of the employee's activities.

"We do not think that the company can be held a retail or service establishment within the meaning of the act. The labor of its employees was performed almost altogether in rendering service to commercial and industrial concerns, where the cost of the services would not be absorbed by the one to whom they were rendered but would be passed on as a part of the price of the product."

•

Weston 1943 Refund Set

Weston Electrical Instrument Corp. has informed stockholders that a final agreement has been concluded with the War Department Price Adjustment Board relating to 1943 contracts, providing for a total refund of $4,700,000 or an additional refund of $1,700,000. This exceeds by $200,000 the amount provided by the company as shown in the annual report.

NIGHT LIGHT EQUALS DAYLIGHT—To operate 24 hours a day, the Marinship Corp. yard Sausalito, Calif., just across the Golden Gate from San Francisco, uses an extremely large electrical illumination system. During the hours of darkness, 150,000 lights, including 900 powerful 1,500-watt General Electric Co. floodlights, are used. In addition, each ship on the ways or docked for outfitting is ablaze with more than 1,200 temporary lights, and each way is illuminated by 200 permanent lights

Appliance Industry Can Play Big Role

The home appliance industry can perform a major role by making available better consumer conveniences and high employment, George T. Stevens, vice-president of the Eureka Vacuum Cleaner Co., told the annual meeting of the National Retail Dry Goods Association in the Hotel Pennsylvania, New York, last week.

"To fully take advantage of the major appliance industry in the post-war period," Mr. Stevens said, "we must plan intelligently now, not only product development and product improvement, but also in our distribution methods as well."

Pointing to the wartime progress in developing new product and manufacturing techniques, he emphasized that the improvement of distribution presents the greatest challenge to manufacturers, wholesalers and retailers.

"It is possible that the weakest link in the chain connecting the future of electrical appliances to prosperity is our distribution system," Mr. Stevens declared. "Most of this is a casualty of the war—manpower cannot and could not be spared for the maintenance of our pre-war organization in any fields."

Calling on department stores to reappraise the rising importance of electrical appliances in their post-war planning, he said that these retailers face a great opportunity in providing leadership in improving distribution. He proposed that department stores might survey customers on the subject of appliance service, study what they are doing to help potential new customers for the appliance market, and chart the potential demand they will have for appliances.

•

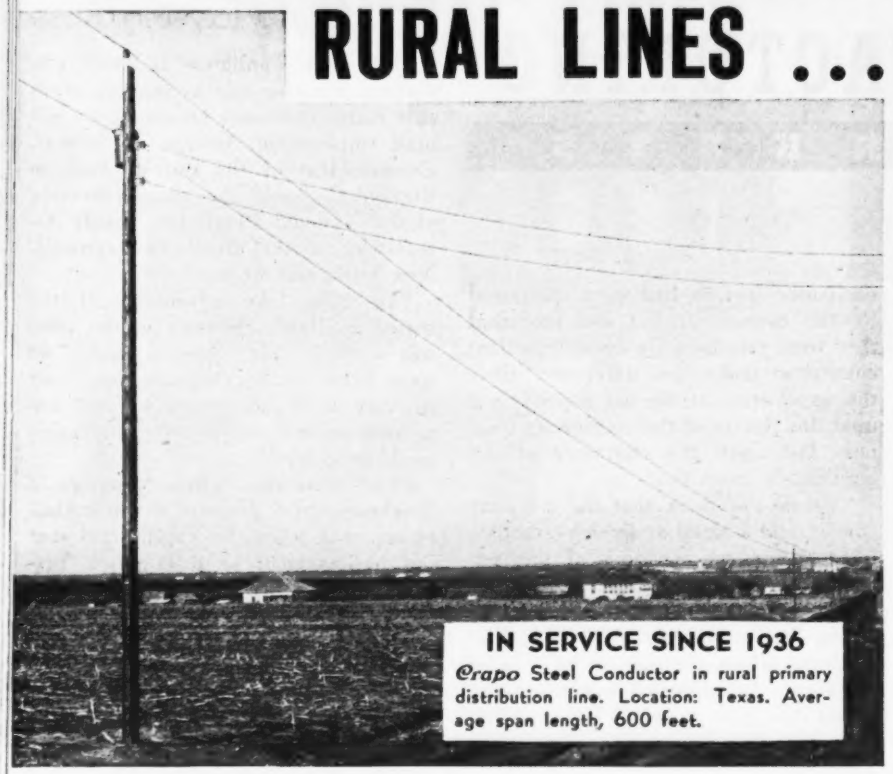
Electric Kitchen Devices Wanted in Better Homes

In the $8,000 to $10,000 homes which will be built after the war, 80 percent of the owners will want new electric ranges, 70 percent new electric refrigerators, 69 percent new electric dishwashers, and 59 percent new electric garbage disposals.

These figures were tabulated from questionnaires submitted by those persons making applications for "personalized" kitchen plans, the $3 service offered with Hotpoint's "Your Next Kitchen" booklet and were released by the Edison General Electric Appliance Co., Chicago.

The company is offering at no cost six standard plans for kitchens. If

FOR LONG-SPAN, LOW-COST RURAL LINES . . .


IN SERVICE SINCE 1936
Crapo Steel Conductor in rural primary distribution line. Location: Texas. Average span length, 600 feet.

Specify Crapo Steel Conductor!

Important economies can be realized where Crapo Steel Conductors are employed in rural distribution systems. Long-span construction, made possible by these high-strength conductors, results in substantial savings both in material and labor costs.

Because of their rugged strength Crapo Steel Conductors have high fatigue endurance limit, high resistance to shock and deformation. Service interruptions, therefore, are minimized, maintenance costs are reduced, where these conductors are employed.

Crapo Steel Conductors are especially applicable to rural branches and taps extending from backbone feeders. Their electrical conductivity is more than adequate to carry the average loads ordinarily imposed on such lines. Voltage drops usually will be less than 3%.

Write for your copy of this Engineering Manual

Distribution engineers now planning rural expansion programs should investigate the economical and practical advantages of Crapo Steel Conductors. The Engineering Manual will bring complete technical information. Ask a representative of Graybar Electric Company, Inc., or write for your copy today!

INDIANA STEEL & WIRE COMPANY -- MUNCIE, INDIANA

Graybar Electric Company, Inc., Distributors

Crapo HTC-130 STEEL CONDUCTORS

none of these is suitable, prospective home builders may secure "personalized" plans drawn especially to fit the dimensions of the proposed kitchen.

Among those who are planning to remodel their kitchens, 48 percent desire new electric ranges, 42 percent new electric refrigerators, 59 percent new electric dishwashers, and 51 percent new electric garbage disposals.

•

Sangamo Employees Vote for Independent Union

Sangamo Electric Co. employees, balloting recently under supervision of the National Labor Relations Board, picked the Selco union, an independent organization, to represent the production and maintenance employees, while A. F. of L. crafts won in two small elections against C. I. O. unions. A total of 1,826 of the 2,134 employees eligible to vote cast ballots in the election.

An agreement made by the Sangamo Electric Co. with an independent union representing 2,200 employees and approved with modifications by the sixth regional War Labor Board at Chicago, provided for rate ranges for various job classifications, based on time studies, with an average increase of less than one cent an hour. The regional board's ruling, which denied a proposed trainee program, did not affect the previous order of the NLRB for the recent election.

•

Noma Group Insurance, Accident Plan Offered

Double duty protection in the form of life insurance and accident and sickness coverage at no expense to its employees has been instituted by the Noma Electric Corp., New York. Henri Sadacca, president has announced. The group plan is being underwritten by the Metropolitan Life Insurance Co. on a basis whereby the entire cost is borne by the employer.

A total of $141,000 life insurance is provided in amounts ranging from $500 to $2,500 for employees on a basis of earnings and length of service. The sickness and non-occupational injury benefits will be from $10 to $15 per week.

•

Moves to Larger Quarters

Announcement has been made by the Lincoln Electric Co., Cleveland, of a new address for its Peoria office. The new office, in charge of L. W. O'Day, manager, is now located in larger quarters in the Electrical Building, 214 Second St.

OVER 200,000 G.I.'S ARE SAFER

W. H. Buckingham Manufacturing Company products are manufactured in quantities for the U. S. Army Signal Corps, U. S. Army Engineers and other branches of the service, as well as for many public utility systems.

W. H. Buckingham Manufacturing Company is recognized for its painstaking care and rigid inspection in the production of tools and supplies for the Man-on-the-Pole. Its "Stephens Climbers" are but one example of the excellence of its many products.

Buckingham Products

POLE CLIMBERS
TREE CLIMBERS
CLIMBER STRAPS
CLIMBER PADS
TOOL BELTS
SAFETY STRAPS
SAM BROWNE BELTS
TOOL POUCHES
PLIERS
PLIER GRIPS, DIELECTRIC
SKINNING KNIVES
SPURS

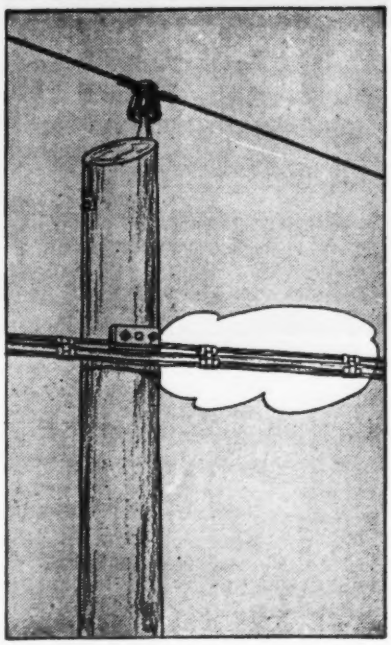
BUILT BY

BUCKINGHAM

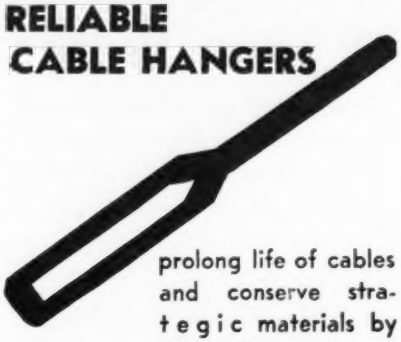
OF BINGHAMTON

W. H. Buckingham Manufacturing Company, Binghamton 5, New York, U. S. A.

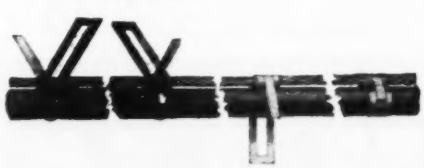
Reduce Outages
Avoid Cable Wear
Reduce Maintenance



RELIABLE CABLE HANGERS



prolong life of cables and conserve strategic materials by eliminating wear on cable sheaths or on insulation of hand made cables. Reliable cable hangers hold cable and messenger together tightly with wide bearing surfaces which eliminate snaking and chafing. They are easily applied and make installations that are permanent and very neat.



Reliable ELECTRIC COMPANY
OVER 35 YEARS SERVING THE UTILITIES

Field Reports on Business

Reports indicate that a higher rate of industrial activity prevails in the country's war plants. Outstanding awards for war materials are being received by manufacturers. Armored cable, magnetic switches, magnet wire and electrical specialties are features. Retail trade, though higher than last year, is spotty.

NEW ENGLAND

A higher rate of industrial activity in war plants in this area is developing. Fisk Rubber Co.'s Chicopee (Mass.) plant is operating at a peak level on a seven day week basis. A 40 percent increase in New England's box making industry is expected after the war; this business is now treble pre-war output and is running into about $30,000,000 per year. Small motor installations and additions to lighting systems are mounting in smaller factories and plants in the Boston area. Several outstanding awards for war materials were received by New England manufacturers last week.

A contract to supply target reflector equipment amounting to $440,000 has been awarded Reed Barton Co., Taunton, Mass. Plymouth Rubber Co. has received an order for 36,000 rolls of friction tape, and Electric Boat Co., New London, Conn., has been awarded a contract to supply 105mm. shells.

An annual contract valued at $75,000 has been received by Spencer Thermostat Co., Attleboro, Mass. Connecticut manufacturers are receiving orders for magnet wire, armored cable, electric specialties, magnetic switches, thermocouples, and machine bearings, the latter running well over $100,000 for the past week.

American Optical Co., Southbridge, Mass. has been awarded a contract for sun-glasses valued at $147,000 and a Massachusetts bedding manufacturer has booked a Navy order for $262,000 worth of bedding. Electrical apparatus purchased last week included electrical timing apparatus, armored cable from Ansonia Electric Co., Ansonia, Conn., Monowatt receptacles, glue heaters from Acme Electric Manufacturing Co., Boston, wiring supplies, and magnet wire.

CHICAGO

New plan construction, expansion of manufacturing facilities and commitments for post-war industrial construction in the Chicago area in December represented an aggregate expenditure of $11,982,000. This development brings the new industrial investments in the Chicago area to a total of $80,807,707 for the year 1944. Industrial development expenditures for 1943 were $162,239,437 and approximately $400,000,000 in 1942. Total industrial facilities for the war period since June, 1940 and comprising federally owned and privately owned plants has now reached the significant sum of $1,061,702,544 according to the Chicago Association of Commerce.

First local unit of warehouses of a special construction for storage of government owned machine tools are to be constructed on a 130 acre plot in nearby Hammond, Ind. The special units are prefabricated metal storage sheds with removable side walls, constructed in sections. This project is under the Reconstruction Finance Corporation. Kankakee (Illinois) Ordnance Works has completed a reconversion of part of the ordnance plant. There has also been some conversion and addition effected at the Elwood Ordnance Works at Elwood, Ill. Crown Rheostat & Supply Co., Chicago, has announced contemplated removal to a new building to be constructed as soon as possible. The transaction involves purchase of 68,000 sq. ft. of ground. The contemplated building will contain about 29,000 sq. ft. Russel Electric Co. has underway plant expansion consisting principally of a testing laboratory for some of the technical equipment under manufacture.

NEW YORK

Civilian goods manufacture will be further drastically curtailed by plans for high expansion of war production, WPB Chairman Krug has revealed.

Despite the many uncertainties to be reckoned with, investment bankers are optimistic regarding the prospects for private financing during the current year. The corporate issues which are lined up for offering during 1945 include many substantial light and power issues.

Cash dividends paid by corporations last year totalled $3,685 million, a 3.3 percent increase of 1943, the Department of Commerce has reported.

Civil engineering construction volume in continental United States totalled $22,891,000 last week. This volume is 70 percent under the total reported by *Engineering News-Record* for the corresponding week of 1944, and compares with $28,809,000 for the holiday-shortened preceding week. The week's construction brought 1945 volume to $51,700,000 for the two weeks, a total 47 percent lower than the $97,777,000 reported in the 1944 period.

Though retail trade was spotty in the Metropolitan area last week, reflecting both shortages of merchandise and adverse weather conditions, it did show a slight increase over the corresponding week of 1944.

PACIFIC COAST

California's probable $1,600,000,000 budget of farm products for 1945 has been aided by well-distributed rain, about double the seasonal fall in the north and tapering to seasonal average in the south. Easier material and installation conditions and the need to supplement electrically any loss of farm manpower by draft are expected to produce considerable electrical agricultural business. Snowfall at key points on the Sierras average 40 inches, about equal to last January's but better packed, say the power men.

Hospitals continue to be a major construction item, with a variety of electrical material included. Electrical material and its installation at San Diego Naval air station is covered by a $175,000 award.

Orders include one year's supply of transformer oil for Los Angeles; a U. S. Engineers order for $100,000 of poles to an Everett, Wash. firm; and a Gamewell fire alarm system for extensive maritime housing at Richmond. The recent appropriation of $145,000,000 of post-war flood control projects in California includes $20,000,000 for irrigation and power systems based upon Pine Creek Dam.

$1,000,000 WORTH OF

New Design

As a part of Universal's own "U" Plan for "V" Day, a million dollars is being expended at the plant to redesign the entire Universal line. Under inspired leadership, an expert staff working in six laboratories is applying extensive research to consumer needs. Skilled designers are combining their talents with those of several of the country's outstanding product design groups...streamlining models for sales appeal...simplifying construction for greater utility... adding new features to meet tomorrow's demands for better living.

WHAT IT MEANS TO YOU!

Universal's reputation has been built primarily on quality, but in the coming competitive period dealers will need not only quality but smartness of design, unique features and new products to broaden markets and increase profits. We guarantee that Universal quality will be maintained. Those who have previewed Universal's post-war products are certain the million dollars for new design is being well spent... forecasting appliance leadership for Universal distributors and dealers.

Add to these factors three million dollars worth of new manufacturing facilities, fifty million customers worth of good will and you gain some idea of the true value of the Universal franchise in your community. *Write or call your nearest Universal distributor for full franchise information. Plan today to join Universal's "Forward March to Market".*

UNIVERSAL

LANDERS FRARY & CLARK · NEW BRITAIN · CONNECTICUT

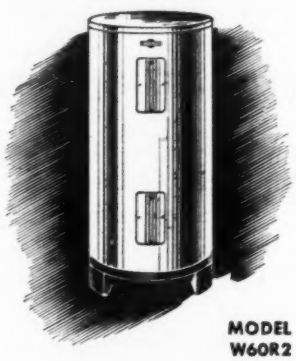
Universal Electrical Appliances distributed in Canada exclusively by Northern Electric Company, Ltd.

ONE MILLION

New Hot Water Customers

The postwar market for automatic water heaters is expected to provide more than one million purchasers by mid-1946! Immediate demand is estimated at 600,000 units. It is tomorrow's greatest load building potential!

In making your postwar plans look to Electromaster, specialist in electric water heaters and ranges. Electromaster Water Heaters will help public utilities in their domestic load building program and at the same time enable them to meet this peacetime demand with a quality, low-cost product.



MODEL W60R2

ELECTROMASTER WATER HEATERS

are designed to give long years of satisfactory operation and to provide easy accessibility for servicing. Three popular sizes will be manufactured when present restrictions are lifted.

ELECTROMASTER INC.
1811 E. ATWATER
DETROIT 31, MICHIGAN

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

Allis-Chalmers Manufacturing Co. has appointed Archibald J. Cooper manager of the New York district office. Mr. Cooper joined Allis-Chalmers in 1909 and succeeds A. F. Rolf, assistant secretary of the company.

Sheldon Service Co. of New York has made Edgar Hubert New England sales manager with offices in the Statler Building, Boston 16.

Thomas & Betts Co., Inc., Elizabeth, N. J., has appointed Karl G. Kempf, Los Angeles, Calif., as Pacific Coast manager and H. C. Moses, Jr., Chicago, Ill., as Chicago and Middle Western manager. Mr. Kempf has been Los Angeles district manager and Mr. Moses was formerly Cleveland district manager.

The Foxboro Co., Foxboro, Mass., has appointed Wendell A. Melton district manager in charge of the Tulsa territory, with offices in the McBirney Bldg., Tulsa 3. Mr. Melton is president of the Engineers Club of Tulsa.

NuTone, Inc., Cincinnati, has appointed L. B. Dreifus eastern sales manager with headquarters in New York. Mr. Dreifus was formerly assistant vice-president of Supplee-Biddle Co., Philadelphia.

•

Bodine Co. Expands Plant

The widespread use of fractional horsepower motors in wartime has required an increase in the plant facilities of Bodine Electric Co., Chicago. Ground has been broken for a two-story addition which will enlarge present capacity approximately 50 percent. Engineering and research will profit by a modern new laboratory for designing and testing Bodine motors from the planning stage to the completed unit.

•

Dresser Industries Unit

Announcement has been made that the Roots-Connersville Blower Corp., Connersville, Ind., has become one of the units in the Dresser Industries, Inc. Two plants are operated in Connersville, and sales offices are maintained in New York, Chicago, Pottstown, Pa., Boston, Pittsburgh, Detroit, St. Louis, San Francisco, and other principal cities.

•

Gets Floodlighting Line

Philadelphia Electrical & Manufacturing Co., Philadelphia, Pa., has announced that it has succeeded the Electric Service Supplies Co. of Philadelphia in the manufacture and sale of Keystone golden flow floodlighting equipment for area and display floodlighting.

STILL—

Enough Electricity

STILL—

Being delivered on time

STILL—

At Pre-War Rates

FOR WAR INDUSTRIES AND THE HOME FRONT

Aid The National Conservation Campaign To Save Fuel, Manpower And Transportation.

★

Enough Electricity For Every Need, But NEED What You Use.

The Hartford Electric Light Company

Landmark of the Free . . .

Between Newport and Providence, R. I., this historic Sycamore Tree is nature's landmark of one of the most dashing exploits of the Revolutionary War. *Etching by Edward C. Smith.*

Just as this famous Rhode Island Sycamore landmarks a place in American History . . . so might the trees of today have a story of their own to tell tomorrow. In trimming trees for Utility Companies, the Asplundh Tree Expert Company preserves the trees and at the same time does the thorough job intended . . . clear light, power and communication lines of tree branches that otherwise might interrupt service.

Asplundh
TREE EXPERT COMPANY
JENKINTOWN • PENNSYLVANIA

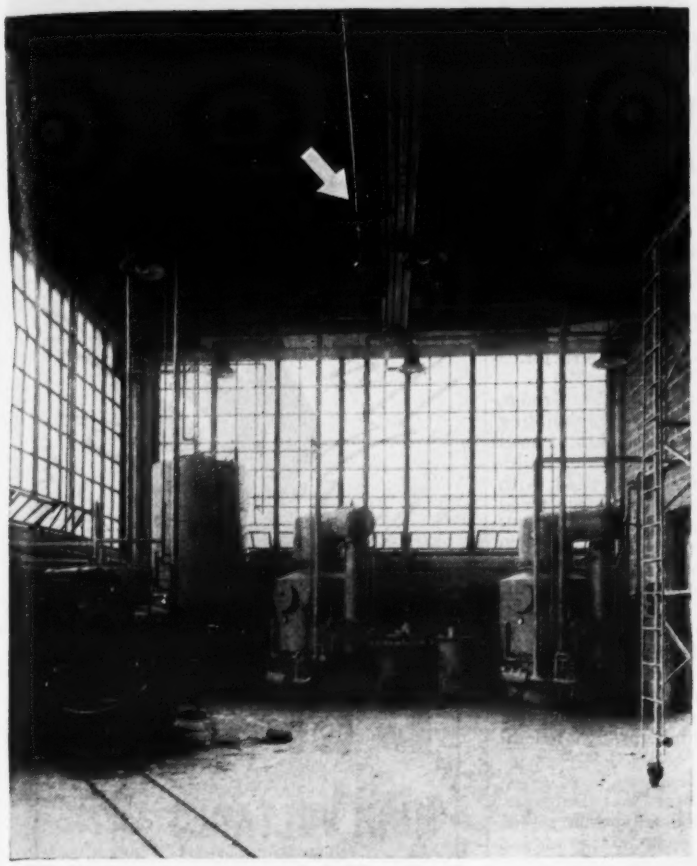
Protected by ONE Cardox Fire

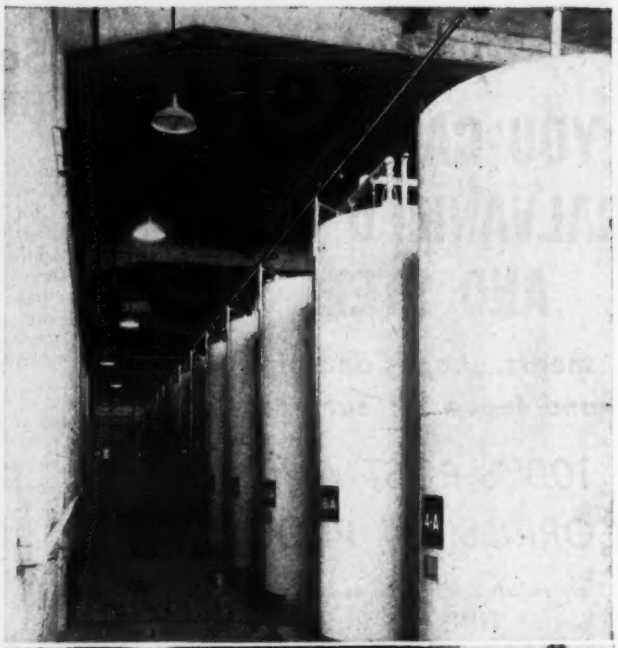
ıe five oil processing and storage rooms illustrated re . . . plus four others and a long pipe tunnel that uld not be photographed . . . represent a major e hazard in one of America's large war plants. All ne rooms and the pipe tunnel . . . 941,140 cubic et . . . are guarded by *a single* engineered Cardox re Extinguishing System.

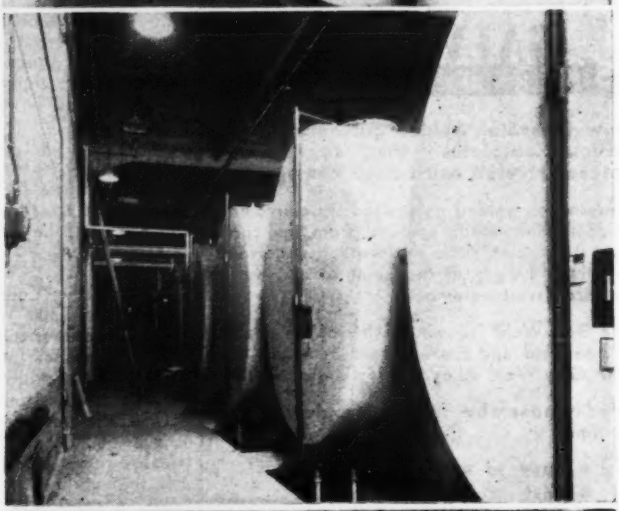
Total flooding of any of these rooms with inert rbon dioxide and CO_2 snow is provided by 12 ns of liquid Cardox CO_2 as soon as fire strikes . with substantial reserve for new emergencies. Here is only one of hundreds of examples of how gineered Cardox Fire Extinguishing Systems utilize st-acting, non-damaging, inexpensive carbon oxide to provide enhanced extinguishing perform- ce in protecting *large* and *small* hazards.

The enhanced extinguishing performance of carbon dioxide, as controlled and applied in Cardox Systems, is due to these four basic factors: (1) It has uniform extinguishing characteristics regardless of plant or atmospheric temperatures; (2) It is available in ample quantity for application at high rate and for total flooding (when necessary) of large areas; (3) It provides high CO_2 "snow" yield for increased cooling effect; (4) It achieves effective projection through relatively great distances—even outdoors.

The hazards in your plant may not be as *large* as those shown here, but the kind of extinguishing performance that has caused Cardox Systems to be specified for guarding hazards such as these has a place in your fire protection plans. Cardox engineers offer you practical cooperation.







Extinguishing System

Write for details and Bulletin 515.

CARDOX CORPORATION

BELL BUILDING • CHICAGO 1, ILLINOIS

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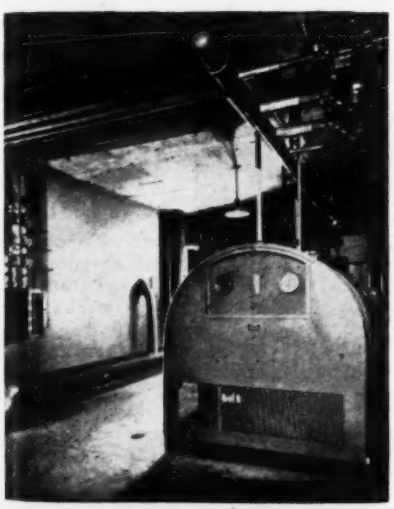


All of the areas illustrated here represent Class B hazards . . . involving volatile and flammable liquids. Total flooding with Cardox CO_2 is applied at the highest practicable rate to create an extinguishing concentration in the minimum length of time. An adequate supply of liquid carbon dioxide to cover all of the hazards illustrated is maintained in a single refrigerated Cardox Storage Unit similar to one pictured at left.

CARDOX

CO_2 FIRE EXTINGUISHING SYSTEMS

NOW

YOU CAN WELD GALVANIZED IRON AND STEEL

sheets, shapes and pipe and leave all surfaces

100% RUST AND CORROSION PROOF

by regalvanizing the seams and joints with the

GALV-WELD PROCESS

New feasable, welded galvanized fabrication obsoletes the conventional, weaker riveted and bolted construction.

Heretofore, welded galvanized structures have been fundamentally unsound from the corrosion standpoint, since the protective galvanizing burned away at the point of and during the process of welding.

The Galv-Weld Process consists of the coating of the weld and the adjacent damaged area with Galv-Weld Alloy at the time of welding.

Readily adaptable to gas, electric and spot welding.

- **Easy to use**
- **Fast**
- **Permanent**
- **No flux required**
- **No fumes**
- **No sandblasting**
- **Cannot be pried or peeled off**
- **Applied in any position and in confined quarters**
- **Economical**

Especially applicable in the case of all welded, stronger, easier erected, lower cost transmission towers; repair of sub-station galvanizing; and transformer cases.

Production-proved in wartime service, Galv-Weld Alloy (Reg. Trademark) has withstood all government tests, and is equal to and/or better than hot dip galvanizing in corrosion resistance. The bond to the base metal is superior to zinc metal spray.

GALV-WELD PRODUCTS

324 E. 2nd St., Dayton, Ohio

Please send, without obligation, information on the Galv-Weld Process and sample of Galv-Weld Alloy.

Name .....

Firm .....

Street .....

City .....

Sales Opportunities

ILLINOIS—Central Illinois Electric & Gas Co., Rockford, will begin work soon on superstructure for proposed addition to generating station for expansion in turbine department. Additional equipment will be installed for increased capacity. Project is understood to have a priority rating. No estimate of cost announced. Stone & Webster Engineering Corp., 33 South Clark St., Chicago, is engineer and contractor.

CONNECTICUT—Electric Boat Co., Groton, will convert one of submarine shipbuilding yards for new plant for production of steel shells for government. A number of buildings will be remodeled and extended, with installation of machinery and electrical equipment for large output. Facilities will be provided for employment of about 1,000 persons. Cost reported over $3,000,000, with financing by government.

NORTH CAROLINA—Ocracoke Power & Light Co., Ocracoke, is reported planning addition to electric power plant, with installation of equipment for increased capacity. No estimate of cost announced. Financing will be secured through federal aid.

IOWA—Interstate Power Co., Dubuque, plans extensions in 2,300-volt primary line. Application has been made for permission and work will be placed under way as soon as secured.

KENTUCKY—"Courier Journal and Louisville Times," 300 West Liberty St., Louisville, has authorized plans for new multistory newspaper printing and publishing plant, with administrative offices, editorial rooms and other departments, to be carried out as a post-war project. Cost reported over $1,500,000, with mechanical and electrical equipment. Also, new rotogravure printing plant for Standard Rotogravure Corp., a subsidiary interest, same address, to cost in excess of $200,000. Lockwood, Greene Engineers, Inc., 10 Rockefeller Plaza, New York, N. Y., is architect and engineer.

MINNESOTA—Rural Cooperative Power Association, Maple Lake, is arranging early call for bids for new transmission line. Pfeifer & Schultz, Essex Bldg., Minneapolis, are consulting engineers.

CALIFORNIA—Public Service Department, Burbank, plans expansion in municipal steam-electric generating plant as a post-war project, including construction of addition to station and installation of equipment for increased capacity. Cost estimated about $1,500,000. Also, will make extensions in transmission and distributing lines in different parts of city, similarly as a post-war development, with enlargement of power substations and other facilities. Cost about $720,000.

ILLINOIS—Monsanto Chemical Co., 1700 South 2nd St., St. Louis, Mo., will carry out expansion in plant for sulfuric acid production for government, comprising several new one-story buildings, with equipment installation for large output. Cost reported close to $750,000, with machinery and electrical equipment. Project will have a priority rating. Work is scheduled to begin soon.

IOWA—City Light Department, Forest City, plans expansion and improvements in

DEFYING

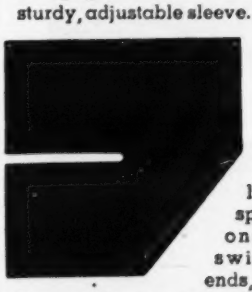
HIGH VOLTAGES *with an* UNEQUALLED MARGIN *of* SAFETY

***Surety* TURN-CUFFS**

The famous petticoat insulator effect minimizes surface creepage. Cuffs turned down add two extra inches of protective gauntlet. Tests prove Surety safest against leakage, puncture, aging. Linemen say they're EASIER TO WEAR!

NON-BINDING SLEEVES

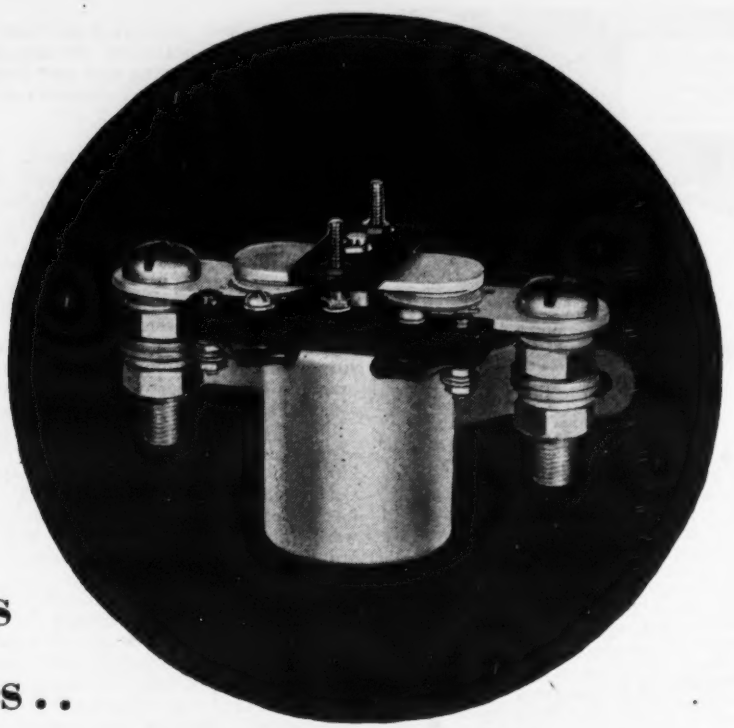
Tough, but not bulky in front. High voltage stock gives maximum protection and long field service. You pay no more for this sturdy, adjustable sleeve.



SLOT-TO-CENTER BLANKETS

Made especially for covering spool and secondary wires, switches, dead ends, transformers. For primary or secondary lines. 45" square, beaded edge, nine eyelets.

THE *Surety* RUBBER COMPANY
CARROLLTON, O.



Tested 50,000 Times at 1000 Amperes.. To Exceed the Toughest "Specs" for this

MALLORY CONTACT ASSEMBLY

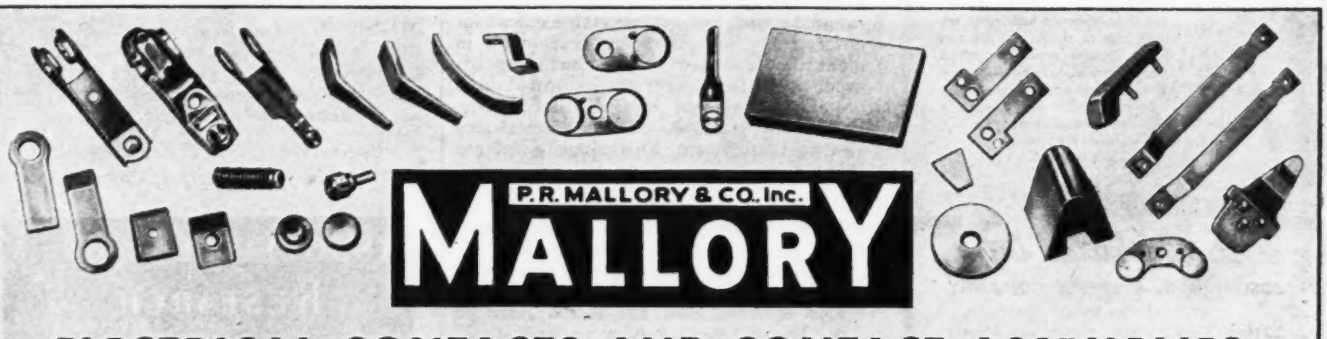
SPECIFICATIONS for the Mallory Contact Assemblies used in this relay are plenty tough—but factory tests are even more rigid. Contacts must make a circuit at 1000 amperes, 18 volts DC, and break the circuit at 250 amperes, 18 volts with an allowable contact temperature rise of 100°C. This "make-and-break" operation must be performed 50,000 times without welding of the contacts! After this test, the contacts must conduct 250 amperes with a loss of potential not to exceed 0.10 volts.

These Mallory Contact Assemblies, made of a new material, Mallory D-54, assure excellent resistance to arcing, high conductivity and good wear resistance—for efficient operation and long life.

Complete contact assemblies available from Mallory may save you considerable engineering and fabricating time. The wide range of both contact and backing materials developed by Mallory metallurgists has earned Mallory the title of "Contact Headquarters." Consult us *before* your product designs are blueprinted. It pays because of Mallory know-how.

Write today for your copy of the Mallory contact catalog. The new Mallory Contact Data Book will be sent gratis to engineers when requested on company letterhead. Available to students, libraries and schools at $2.50 per copy, postage paid.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA



ELECTRICAL CONTACTS AND CONTACT ASSEMBLIES

Photograph illustrates efficient sure grip and automatic release of Multipoint Hook.

SAVE THE POLES

● The Sturd-E exclusive Multipoint Cant Hook speeds up pole handling and saves the poles—its six quarter-inch by half-inch points grip much more firmly than a single point—in addition, they do not penetrate the creosote treatment. Result—no deep stab wounds where water collects and rot can start.

Made in three sizes for handling all poles—from the smallest to the big ones 22 inches in diameter. Every utility that has tested the Multipoint Cant Hook has reordered in ever increasing numbers—it saves poles, time, and cost.

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a TRUE TEMPER PRODUCT

MULTIPOINT CANT HOOK

6 points, ¼" x ¼" in size grip the pole securely but leave no deep hole to encourage rot and decay. Points renewable when worn. Furnished in small, medium and large sizes for handling poles up to 22" in diameter. Prices and complete description on request.

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municipal power plant as a post-war project, including installation of new diesel engine-driven generating unit and auxiliary equipment. Surveys and estimates of cost will be made soon.

MISSISSIPPI—Water Department, Yazoo City, will receive bids until January 30 for motor-driven turbine pumping unit, controls and auxiliary equipment, in connection with extensions in water system. J. B. Williams, Yazoo City, is consulting engineer.

CALIFORNIA—Universal Sanitary Mfg. Co., New Castle, Pa., manufacturer of vitreous china plumbing fixtures, plans new branch plant as a post-war project. Tract of over 200 acres of land has been acquired. It will consist of a main one-story building and several auxiliary structures, with tunnel kilns and other facilities for large capacity. Cost estimated close to $500,000, with mechanical and electrical equipment. Edward C. and Ellis W. Taylor, 803 West 3rd St., Los Angeles, are architects.

MICHIGAN—Electric Light Department, Bay City, has plans in progress for extensions and improvements in municipal distribution system, including overhead and underground lines, with expansion in power substation facilities. Program will be carried out as a post-war development and is reported to cost close to $175,000, with equipment. Ayres, Lewis, Norris & May, Inc., Ann Arbor, is consulting engineer.

CALIFORNIA—Aerojet Engineering Corp., 285 Colorado Ave., Pasadena, manufacturer of aircraft apparatus, will make extensions in branch plant for production for government, including installation of mechanical and electrical equipment for increased capacity. Cost estimated about $200,000, with financing by Defense Plant Corporation. Work is scheduled to begin soon.

OHIO—Columbus & Southern Ohio Electric Co., Columbus, is completing plans for addition to steam-electric power plant, for expansion in steam division. Work will include installation of new high-pressure boiler, coal and ash-handling equipment, coal pulverizing apparatus, motor-driven pumps, controls and auxiliary equipment. Cost reported close to $1,400,000. Bids are expected to be asked soon. Project is understood to have a priority rating.

NEW YORK—New York City Tunnel Authority, 200 Madison Ave., New York, plans new six-story garage and service building, with frontages of 312 ft. and 200 ft., on thoroughfares. It will be carried out as a post-war project and is estimated to cost about $1,900,000, with mechanical and electrical equipment.

INDIANA—Merchants Distilling Corp., Terre Haute, operating local distillery, now in production for commercial alcohol for government, will carry out expansion in plant for increased output, including by-products division for manufacture of high protein animal feed from distillery waste. Cost about $425,000, with mechanical and electrical equipment. Financing by Defense Plant Corporation. Work will be carried out at once.

OHIO—Water and Electric Light Department, Arcanum, plans expansion and improvements in municipal power plant, with installation of additional equipment. C. J. Simon & Associates, 238 North Harrison Ave., Van Wert, consulting engineers, will make surveys and estimates of cost. It is understood that this will be a post-war project.

Be Prepared for Approaching Spring!

GROUND Resistance TESTING

Associated Research

VIBROGROUND

means Accuracy... Ease... Speed... in plant or field

No. 255 NEW MODEL

VIBROGROUND

Especially developed for conditions of extreme moisture and dryness, too. Four ranges, very low to very high. Design effectively excludes "strays" from high potential networks, DC ground currents or any AC commercial frequencies. One-hand operation. No laborious calculations. No extraneous errors. Range 0-3, 0-30, 0-300, 0-3000 ohms.

NO HAND CRANKING

Reliable self-contained power source. Welded one-piece metal case watertight, assuring accurate readings on sodden ground. Case positively insulated from mechanism. Compact. Easily portable. Makes complete, ACCURATE test more quickly than any other means.

MODEL 251 VIBROGROUND
for average conditions

Model 251 embodies above features except that it has a triple range: 0-12.5, 0-125, 0-1250 ohms. Both models come complete with batteries, ready for operation. Send for Bulletins with complete data.

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THIS BOOK GIVES YOU THE *"Straight Goods"*

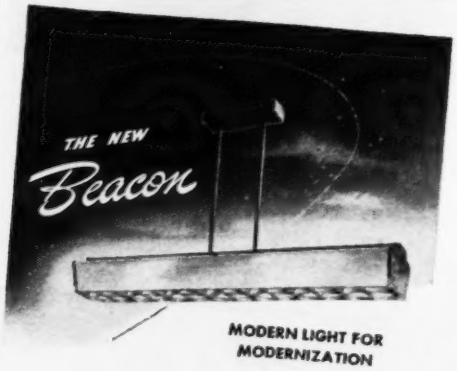
That's why in our honest opinion you'll find it a useful supplement to your own postwar thinking about lighting, because:

1. It isn't speculative. The information it contains on markets is "straight goods" gathered right at market sources during a recent field survey.
2. It isn't a hodge-podge of charts, figures and strained arguments. Important sales possibilities are presented simply and, we think, honestly.
3. The sales, advertising and promotional suggestions it contains are all by reliable men who know utilities. They don't aim to sell you schemes; they do aim to present the industry's most up-to-the-minute ideas in forms which you may adapt to your own territories if you deem it desirable.

We will mail your copy immediately upon request—and if you'd care to favor us with your own opinion on this book, we'd certainly be more than delighted. We're thinking of postwar services, too.

Sincerely,

A. F. Wakefield



MODERN LIGHT FOR MODERNIZATION

How Wakefield can help you . . . .

Wakefield lighting equipment is engineered for top efficiency and for pleas ing overall effect. But we believe that's only part of a good lighting job And that's why Wakefield is always glad to work with you for engineerec lighting installations. Typical of the Wakefield units that can help you or essential jobs now is the BEACON. Modern and clean-lined in design it provides high quality light at lower cost. Rigid louvers hinged for easy maintenance. Foolproof sockets help prevent accidents. Write for details

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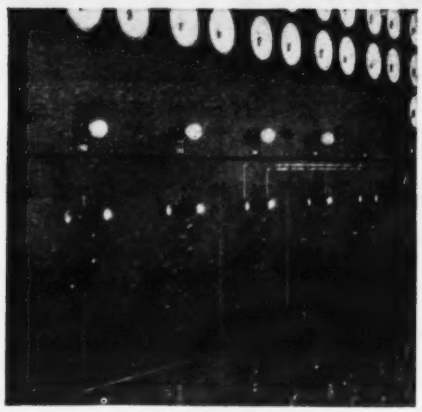
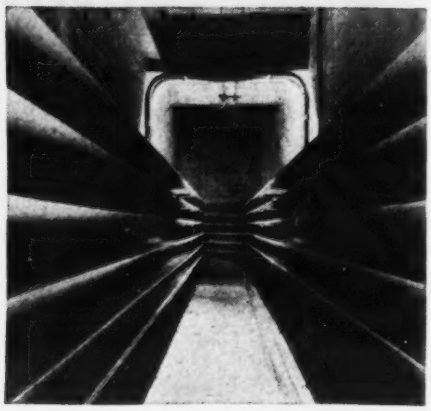
THE F. W. WAKEFIELD BRASS COMPANY • VERMILION, OHIO

Safeguard Future

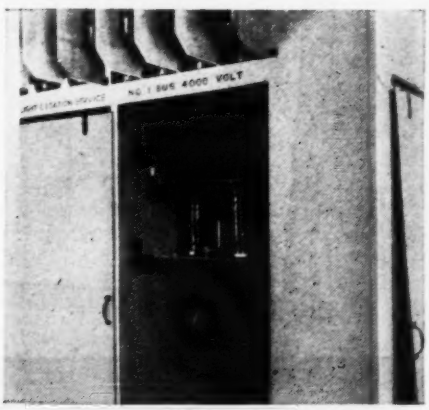


ASBESTOS EBONY is a permanent, inorganic mineral product. It won't rust, rot, shrink, crack or buckle. Impervious to water, gas, oil, and ordinary chemicals. Has high dielectric strength and insulation resistance.



TRANSITE CABLE TRAYS are made of an incombustible, strong, corrosion-resistant material. Designed to support cables. Transite Cable Trays save space, provide greater accessibility, cost less to install and need no maintenance.

SEALING COMPOUNDS. J-M makes several—Duxseal, Pakseal, Tranolseal and Uniseal, each one with special characteristics. All are easily workable at 35° F., with no slump at 300° F. They won't harden materially when exposed to air.

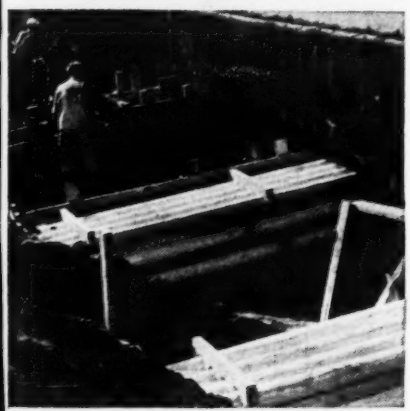


TRANCELL sheets are lightweight, strong, fire-resisting . . . excellent for cell structures, doors, and partitions. J-M Trancell conserves space, reduces floor loading, saves cost, since equipment can be bolted directly to it.

Construction...

PLAN TO USE THESE *Safer* ELECTRICAL MATERIALS

CABLE FIREPROOFING. Niagrite-Asbestoment, consisting of Niagrite, a commercially pure asbestos felted tape with or without reinforcement, and Asbestoment, an efficient refractory material, provides fireproof protection for cables.



TRANSITE CONDUIT and KORDUCT, made of asbestos fiber and cement, are fireproof, highly resistant to corrosion, electrolysis, and soil chemicals . . . are readily installed. Transite Conduit needs no concrete envelope underground.

WHEN the green light "Go Ahead!" flashes for plant renewal and future expansion . . . *be ready to put these dependable Johns-Manville Electrical Materials to work for you.*

During the past critical years of sustained peak loads, J-M materials have helped engineers avoid waste and cut costs . . . by savings on installation expense, by reduced fuel consumption. And J-M Electrical Materials help further by providing an *extra* margin of safety!

Developed in the extensive Johns-Manville Research Laboratory, J-M-Electrical Materials are backed by the know-how acquired through 87 years of experience in solving construction problems.

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Control Boards, Panels, Cabinets, Housings, Special Designed Steel Cubicles, are shaped formed and welded in our Modern Plant. Our Littleford Engineers have designed the most intricate structures and their experience is your assurance of quality products. Send blueprints and specifications; let these Littleford Engineering Specialists show you how to cut costs in construction.

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LITTLEFORD BROS., INC.
421 E. Pearl St., Cincinnati, 2, Ohio

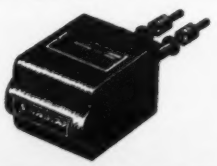
Royal-ettes

#3 in a series of informative news letters from a producer of Power Switching Equipment.

We should like to be able to tell the world that the power industry has been able to make the progress it has primarily because of new designs brought out by Royal. Quite the opposite is true, in a large sense. We are frank to admit that nearly 100% of the items shown in our catalog are the results of definite field requirements of our customers—developments in which we were fortunate enough to participate. If we did not accept suggestions and designs offered to us by our customers there would be fewer items listed in our catalog.

We have schooled our whole organization to be alert for new ideas. A few years ago, while expounding this philosophy to Charlie Highleyman of Indiana and Michigan Electric Co. in South Bend, he suggested we make an electric counter. It was to be small, accurate, take very little energy to operate, and cost about ten bucks. We knew nothing about electric counters, but decided to have a go at the problem.

If you have your copy of our catalog handy, turn to page 215. There it is, our type MA electric counter, the result of about six months of experimentation. It meets all of Mr. Highleyman's requirements. Although originally intended for circuit breaker applications, its uses have grown far beyond anything we had in mind at the start.



ROYAL ELECTRIC MFG. CO. 619 E. 40th Street CHICAGO 15, ILL.

REA Allots Funds; Contracts Approved

Recent allotments approved by the Rural Electrification Administration total $3,008,000, to 26 co-ops in 15 states. This brings the total to date to $518,583,301, of which $19,703,500 represents operations during the current fiscal year.

The funds will be used mainly to provide for extension of electric service to farms located near existing lines. No construction will be undertaken which does not meet with approval of the War Production Board.

Allotments include the following:

FLORIDA—Suwanee Valley Electric Cooperative, Inc., Live Oak, $50,000.

ILLINOIS—Edgar Electric Cooperative Assn., Paris, $50,000; Southwestern Electric Cooperative, Inc., Greenville, $50,000.

KANSAS—Nemaha-Marshall Electric Cooperative Assn., Inc., Axtell, $15,000.

MARYLAND—Southern Maryland Electric Cooperative, Inc., La Plata, $1,470,000.

MINNESOTA—Douglas County Cooperative Light & Power Assn., Alexandria, $80,000; North Pine Electric Cooperative, Inc., Finlayson, $50,000; Wright-Hennepin Cooperative Electric Assn., Maple Lake, $25,000.

MISSISSIPPI—Jones County Electric Power Assn., Laurel, $100,000.

MISSOURI—Southwest Electric Cooperative, Bolivar, $50,000; Missouri Rural Electric Cooperative Assn., Palmyra, $30,000.

MONTANA—Yellowstone Valley Electric Cooperative, Inc., Huntley, $25,000.

NORTH CAROLINA—Central Electric Membership Corp., Sanford, $150,000.

OREGON—Northeast Clackamas County Electric Cooperative, Inc., Sandy, $50,000, including $3,500 for the purchase of a small generating unit.

PENNSYLVANIA—Jefferson Electric Cooperative, Inc., Brookville, $155,000.

TEXAS—Swisher County Electric Cooperative, Inc., Tulia, $75,000; Johnson County Electric Cooperative Assn., Cleburne, $60,000; San Bernard Electric Cooperative, Bellville, $60,000; Wise Electric Cooperative, Inc., Decatur, $40,000; Trenton Refrigeration Cooperative, Inc., Trenton, $7,000; Bowie-Cass Refrigeration Cooperative, Inc., Douglassville, $6,000.

VIRGINIA—Accomack-Northampton Electric Cooperative, Parksley, $25,000.

WASHINGTON—Public Utility District No. 1 of Kittitas County, Ellensburg, $60,000.

WISCONSIN—Grant Electric Cooperative, Lancaster, $150,000; Vernon Electric Cooperative, Westby, $100,000; Eau Claire Cooperative, Eau Claire, $75,000.

The series of construction bulletins, suspended in 1942, has recently been revived. Construction contracts approved recently include the following:

IOWA—Clarke Electric Cooperative, Inc., Osceola, contract to A. A. Electric Co., Cicero, Ill., 105 miles of line, labor only; bid, $95,566. Linn County Rural Cooperative Assn., Marion, contract to Jacobs & Doyle Construction Co., Edgewood, Iowa, 92 miles of line, labor only; bid, $30,420.

KENTUCKY—Hickman-Fulton Counties Rural Electric Cooperative Corp., Hickman, contract to L. O. Brayton & Co., Dyersburg, Tenn., 65 miles of line, labor only; bid, $24,473.

NEBRASKA—McCook Public Power Dis-

trict, McCook, contract to Platte Valley Electric Construction Co., Littleton, Colo., 63 miles of line, labor only; bid, $19,771.

NORTH CAROLINA—Jones-Onslow Electric Membership Corp., Jacksonville, contract to Little Electric Co., Union, N. C., construction of a substation (exclusive of transformers) and 0.4 miles of tie line, labor only; bid, $2,678. Woodstock Electric Membership Corp., Belhaven, contract to Boyle Construction Co., Sumter, N. C., 16 miles of line and two substations; bid, $15,576.

NORTH DAKOTA—Nodak Rural Electric Cooperative, Inc., Grand Forks, contract to Lake Electric Co., Devils Lake, N. D., 106 miles of line, labor only; bid, $22,689. Verendrye Electric Cooperative, Inc., Velva, contract to Sorkness Construction Co., Fargo, N. D., 38 miles of line, labor only; bid, $7,493.

SOUTH CAROLINA—Santee Electric Cooperative, Kingstree, contract to Little Electric Co., Charleston, S. C., 15 miles of line, labor only; bid, $3,498.

TEXAS—Trenton Refrigeration Cooperative, Trenton, contract to L. F. Sutherland and Lawton Wilson, refrigeration plant with capacity of 408 lockers; bid, $32,300. Upshur Rural Electric Cooperative Corp., Gilmer, contract to Electric Contracting Co., 50 miles of line, labor only; bid, $14,979. Deep East Texas Electric Cooperative, San Augustine, contract to Universal Electric Construction Co. of Alabama, Houston, Texas, 5 miles of line, labor only; bid, $790.

WYOMING—Carbon Power & Light Co., Saratoga contract to Vance Electric Service, Salt Lake City, Utah, 56.2 miles of line and two substations; bid, $59,487.

•

Lighting As Load Builder Topic of New Book

The importance of lighting as a load builder is stressed in a book entitled "Your No. 1 Load Building Opportunity," published by the Westinghouse Lamp Division, Bloomfield, N. J.

The book discusses the converting of wartime generating capacity to new profitable loads; gives a breakdown of residential, industrial and commercial lighting projections leading to the use of 65 billion kw.-hr. in 1948, (it was assumed the European war would end in 1944, and the Pacific war in 1945); analyzes the sales opportunity for lamp manufacturers and the lighting industry, concluding with the caption, "The entire lighting industry has a $1,500,000,000 opportunity provided that we think big and act now."

•

Name Change Announced

To reflect more accurately the business of the company, Utility Fan Corp. of Los Angeles changed its name on January 1 to Utility Appliance Corp. Starting in 1925 as a manufacturer of ventilating equipment, the organization now produces and distributes a wide range of air cooling, air moving, and gas-fired heating appliances.

HOW TO HELP CREWMEN FIGHT THE COLD

UH-5B 7" x 10" x 10"

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BULLETIN HG-4 Describes all types of Hunter Heaters

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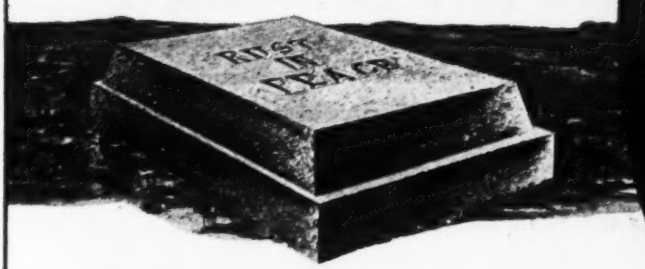

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Recent Rate Changes

BOSTON EDISON CO. has filed wholesale power rates with the Massachusetts Department of Public Utilities effective January 1 to meet conditions arising principally from variations and reductions in the loads of customers engaged in war work. In the specified rates (D-1, G, and G-1) the company employs a so-called "demand ratchet" in common with general utility practice, which in this company provides that the billing demand for any month shall be not less than two-thirds of the highest demand during the 11 preceding months. As the war progresses the company anticipates changes in and cancellations in such customers' war contracts, and that at the end of hostilities their demands on the company may reduce sharply. About 1,000 customers are using these rates. Since individual consideration cannot necessarily be given as rapidly to such cases as might be desired, the company is waiving the ratchet provisions in these rates for two years, thus providing for automatic adjustment of billing demands to current conditions.

WESTERN MASSACHUSETTS ELECTRIC CO. has been authorized by the state Department of Public Utilities to establish an experimental farm line schedule effective January 1, applying to year-round farms served by single-phase extensions built after the above date. Community domestic rates apply with the following guarantees: (A) $2 per month per farm customer (as defined by the U. S. Government's 1945 Agricultural Conservation Program) for any line extension of one-third mile or less to serve one customer, or for any extension having three or more farm customers per mile; (B) for any farm line extension of more than one-third mile to serve a single farm customer, or for any extension having less than three customers per mile there will be added (to the above $2) 35 cents per month per farm customer for each 100 ft. or fraction by which the extension exceeds one-third mile per farm customer. The company reserves the right to refuse any extension over highly unfavorable terrain, where costs are extraordinary. Regular domestic rates without guarantee will apply after five years.

PUBLIC SERVICE CO. OF NEW HAMPSHIRE has reduced substantially the rural extension guarantees which it requires by a new schedule effective January 1. No guarantees are now called for other than the minimum charges established by the applicable rates when the average distance between customers is 1,320 ft. or less. Previously guarantees were required when this distance exceeded 300 ft. Where the average distance exceeds 1,320 ft. monthly guarantees are established for five years based on a charge of $1 for the first 1,320 ft. per customer plus (a) 23 cents per month per 100 ft. (for 1,320 to 1,760 ft.); or plus (b) 33 cents per month per 100 ft. (for 1,760 to 2,640 ft.); or plus (c) 43 cents per month per 100 ft. (for 2,640 to 5,280 ft.). Unserved potential customers are counted as one-half a customer in determining the average distance. Guarantees applicable to any individual extension will be terminated in less than 60 months if and when the total amount of electricity used in any consecutive period of 12 months is sufficient, when billed at regular rates, to yield a sum equal to or greater than the sum of all guarantees.

HOLDEN, MASS., municipal light department has announced a rate reduction effective January 1, 1945, for domestic consumers from 7 cents per kw.-hr. to 6 cents each, for the first 25 kw.-hr. used per month.

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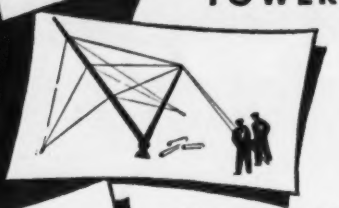

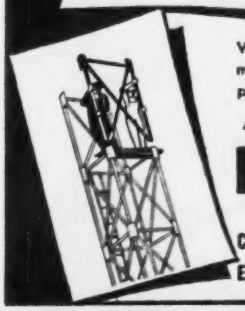

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NEW ENGLAND POWER SYSTEM representatives have announced that total rate reductions aggregating $98,730 per year will be established if the Massachusetts Department of Public Utilities approves the pending petitions for the consolidation of Leominster and Middlesex County companies with the Wachusett Electric Co., and of the Milford and Union Electric (Franklin) companies with the Worcester Suburban Electric Co. The commission has taken the cases under advisement.

COWLITZ COUNTY (WASH.) PUBLIC UTILITY DISTRICT has announced a reduction in residential electric rates which will mean a saving of approximately $17,000 annually to consumers.

CENTRALIA'S (ORE.) municipal hydroelectric system, having retired its last indebtedness on January 1, announced an over-all reduction of 12 percent in rates for city light and power users, the decrease going as high as 24 percent for general light customers. Mayor Ray W. Sprague released figures showing the new rate setup means an average decrease of 24 percent for general city users; a drop of 20 percent for general users; and an average decrease of 10 percent for both city and light combination customers. A 10 percent discount given to light customers for bill payments before the tenth of each month would remain effective.

B. C. ELECTRIC RAILWAY CO. has been ordered by the B. C. Public Utilities Commission to reduce its basic electric light rates for the southern area of Vancouver Island. Dr. W. A. Carrothers, chairman of the commission, estimates the reduction will approximate one month's domestic billing. In the past two years the commission has ordered the B. C. Electric Railway Co. to supply power free for two months to customers in the southern Vancouver Island area, as compared with one month free power to domestic consumers in other parts of British Columbia served by the Company. Presumably if a similar free period is declared next year, the southern Vancouver Island area through the new general reduction will be placed on the same basis as the rest of the territory in regard to the duration of its free light and power service, if any. The rate reduction, which became effective January 1, will mean a total savings to consumers of $112,000 per year, or approximately 10 percent of the average householder's monthly bill, it was announced jointly by Dr. Carrothers, and by A. T. Goward, Vancouver Island vice-president of the B. C. Electric Railway Co.

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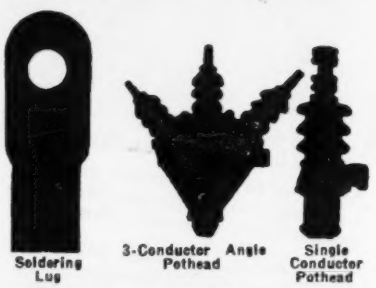

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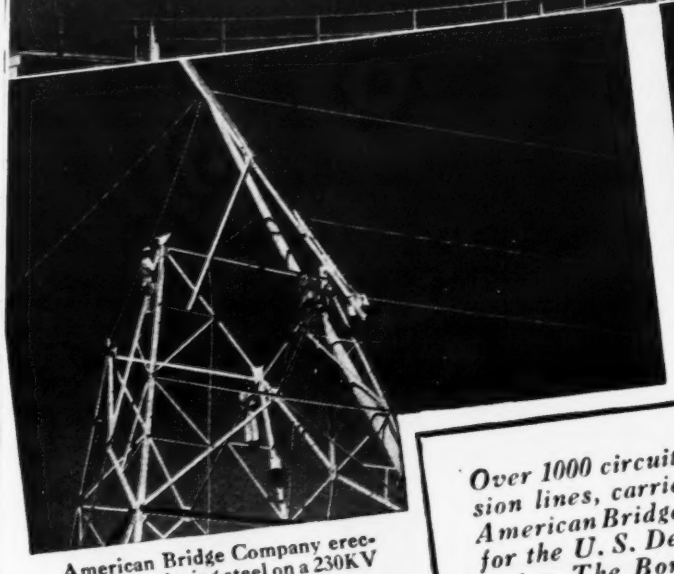


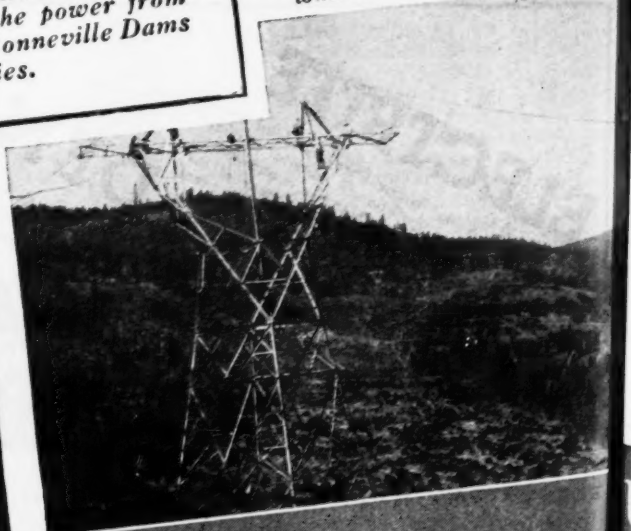
American Bridge Company erection crew placing steel on a 230KV single-circuit, dead-end tower.

Perched on a rocky butte, a double-circuit tower; to the left, two single-circuit towers.

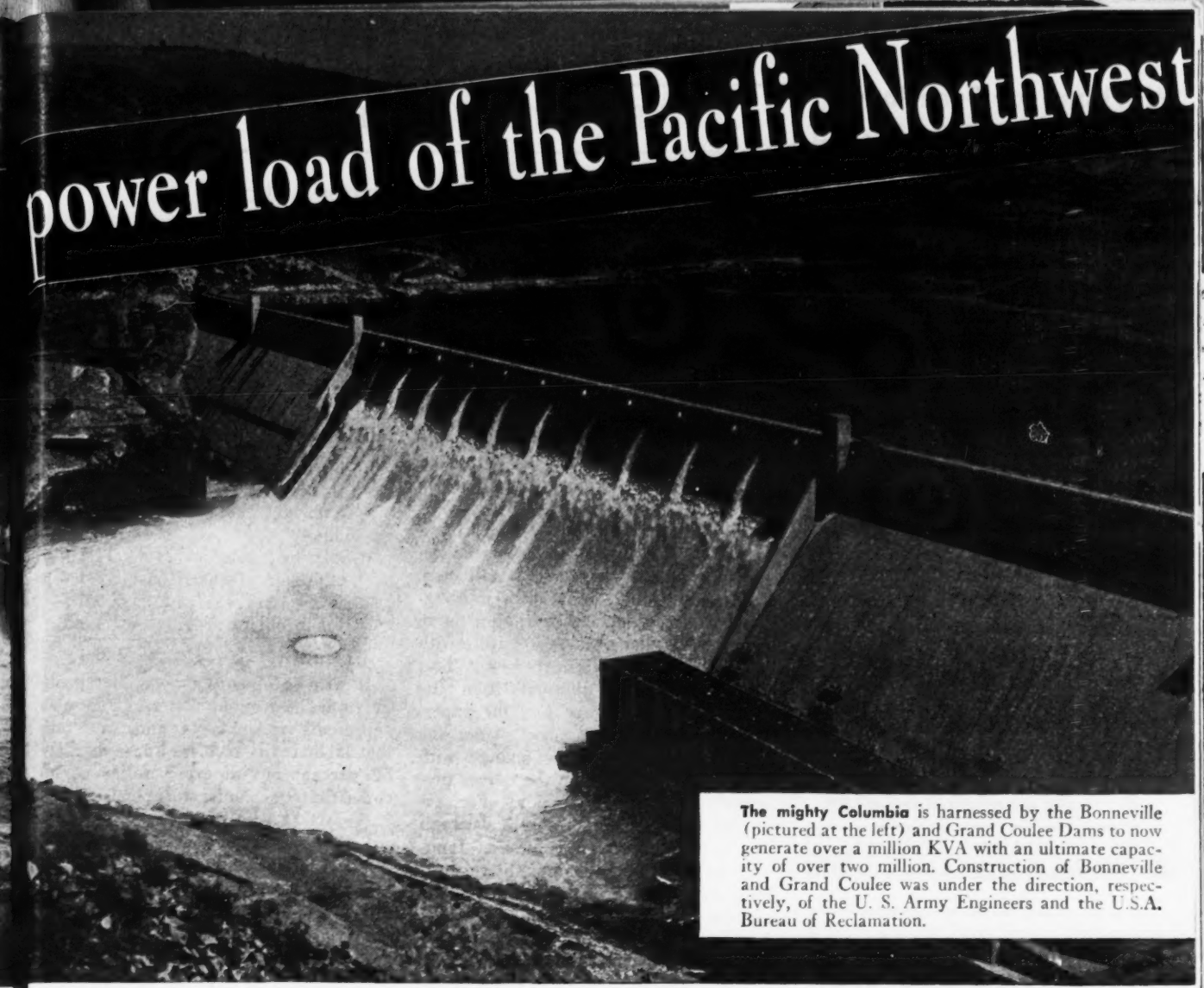
Over 1000 circuit-miles of transmission lines, carried on thousands of American Bridge steel towers—built for the U. S. Department of the Interior, The Bonneville Power Administration—feed the power from Grand Coulee and Bonneville Dams to vital war industries.

Erecting a 230KV single-circuit tower of the rotated type.

Twin transmission-line towers tailored to side-hill descent.



power load of the Pacific Northwest



The mighty Columbia is harnessed by the Bonneville (pictured at the left) and Grand Coulee Dams to now generate over a million KVA with an ultimate capacity of over two million. Construction of Bonneville and Grand Coulee was under the direction, respectively, of the U. S. Army Engineers and the U.S.A. Bureau of Reclamation.

THE Pacific Northwest's major power systems—now interconnected and pooled as a war measure—provide a vast reservoir of electrical energy, each "kilowatt-hour" of which is effectively made to serve the tremendous load-demands of countless industries, homes and irrigation projects now playing a vital part in the giant production needs of a nation at war.

The Grand Coulee and Bonneville Dams, which harness the flow of the mighty Columbia River, constitute the major block of generation for this vast Northwest system. These notable projects with their integrated transmission-lines for power distribution are outstanding examples of America's engineering resourcefulness. Planned and built prior to Pearl Harbor, they now stand the nation in good stead, putting vital electrical power to work on war production.

American Bridge shared extensively in the structural steel requirements of these projects. As subcontractor to Columbia Steel Company, it fabricated and erected the huge, vertical-lift gates for the spillway of Bonneville Dam. For Grand Coulee, it furnished not only the giant, spillway drum gates that rise as they roll, but also penstock gates, power house framework and other miscellaneous steel parts.

And many of the transmission lines radiating from these two sources of power are carried on American Bridge towers of rotated and special types. Scaling the heights and cutting great swaths through forested river bottoms in their traverse of the rugged, virgin country of the Cascade Mountain range, they were engineered for heavy-duty service under extremes of climatic conditions, and tailored to hazardous side-hill and rocky butte formations.

Today, American Bridge Company's resources are engaged in all-out work for our nation at war. Tomorrow, we shall enter the peace prepared with greater facilities and capacity than ever to meet the needs of the postwar program of power development.

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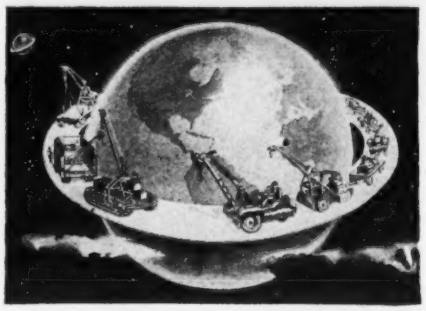

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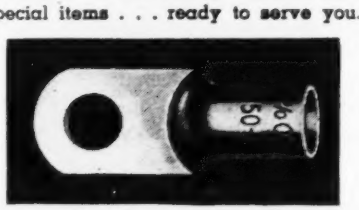

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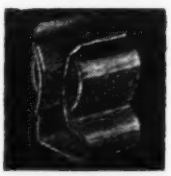

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LETTERS TO THE EDITOR

Earth Temperature Lags

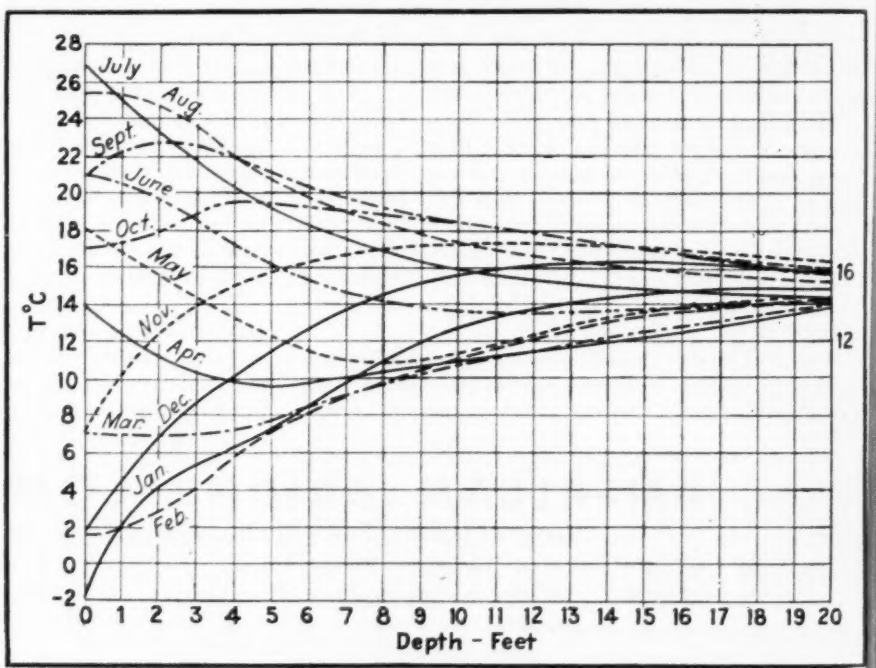
To the Editor of ELECTRICAL WORLD:

We have read with considerable interest the article by Mr. Hieronymus in the December 9, 1944 issue of ELECTRICAL WORLD entitled "Earth Ambient Temperatures for Cable Loading Limits". We have been acquainted with this study which has been carried out by Mr. Hieronymus for several years and feel he has contributed some very valuable information as to the rate of change in temperature at various depths as the air temperature varies.

We have been fortunate in obtaining from Mr. Hieronymus some of the detail information which he has collected, and as a result, for our own information we drew the accompanying curve showing the change in temperature with depth for each month in the year. This curve is slightly different from the curve shown in Figure 7 of the paper. We believe that our curve shows the time lag of temperature change with depth more clearly than the curves presented by Mr. Hieronymus. For example: for the two foot depth, although the air temperature is coldest in January, the effect of this is not shown until February. Likewise, although the highest temperature at the surface is found in July, the effect does not show up until August for the two foot depth.

Perhaps some of your readers might be interested in our curve (below).

R. J. Wiseman
Chief Engineer
The Okonite Co.
Passaic, N. J.



Labor's Share

To the Editor of ELECTRICAL WORLD:

I have just been reading the editorial in the November 25 issue of Electrical World about labor's interest in promoting more adequate wiring and it occurs to me that you and your readers might be interested in some specific figures that I had occasion to have taken off our books for 1944 that show labor's interest in the volume of business done by an electrical contractor:

	Percent
Material	33.7
Labor	38.2
Salaries	11.2
All other overhead	6.4
Taxes	9.0
Net Profit	1.5
Total Sales	100.0

It will be obvious to you that probably one-third of the material item also represents labor costs and therefore that labor really receives approximately 50 percent out of every dollar of income that the contractor receives.

F. E. Boyd, President,
Pacific Electric Motor Co.
Oakland, California.

•

Abnormal Voltages at Potential Transformers

To the Editor of ELECTRICAL WORLD:

The second case of trouble outlined by Messrs. Harper and Coxe in their article "Unusual Troubles with High-Voltage Transformers" in your issue of December 9, 1944, recalls experiences

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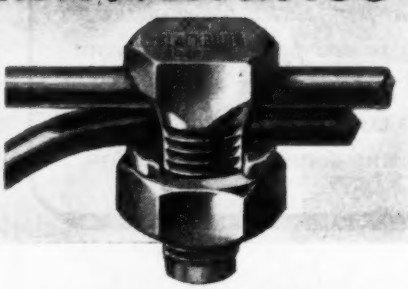

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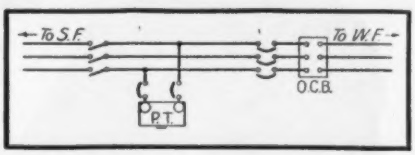
of the writer some years ago, and which have recurred in modified forms.

The particular case involved the synchronizing of two systems at 38 kv. The incoming line ended at an outdoor switching structure arranged as indicated in the sketch. A 44-kv. potential transformer was connected between phases, the secondary from which was taken to the control panel and supplied the synchronizing indicator. It was observed that when the potential transformer was excited from one end only the other bushing showed signs of very high electric stress, corona and even



static streamers. Measurements indicated in one case 62.5 kv. to ground and the other 69.5 kv. to ground. The only observable difference in the two cases was that the higher value was obtained on the bushing to which a few feet more of bus conductor, supported on two additional insulators, was attached.

The equivalent reactance of a potential transformer of this type with very low secondary burden may approach several megohms in value. The charging current to the bus structure, while small, was not negligible and in the case given by Harper and Coxe the capacity current between the 13.2-kv. transformer windings and ground must have been quite appreciable. From standard circuit theory it may be shown that a leading component of current drawn through reactance results in a boost in the voltage. Such a phenomenon of course is associated with conditions in a circuit approaching resonance but it also occurs in some degree under conditions which may be quite removed from resonance but can be hazardous to equipment. Under some circumstances it can be aggravated by drawing an arc at the disconnecting switch.

The simplest general method of limiting the voltage which might develop seems to be to add an appreciable burden to the potential transformer used for this purpose, thus lowering the effective reactance of the transformer and the writer would suggest a careful study of this procedure as a precautionary measure. In this case, substantial improvement was effected by opening the potential transformer disconnecting switches before closing those on the line. It might not always be convenient for the operator to go to this extra work even if he were aware of the high voltage hazard and a more positive protection would seem desirable.

W. B. Buchanan, Testing Engineer,
Hydro-Electric Power
Commission of Ontario

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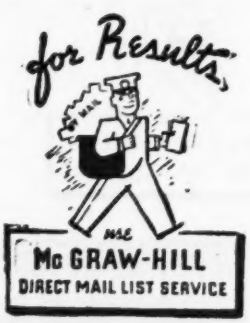

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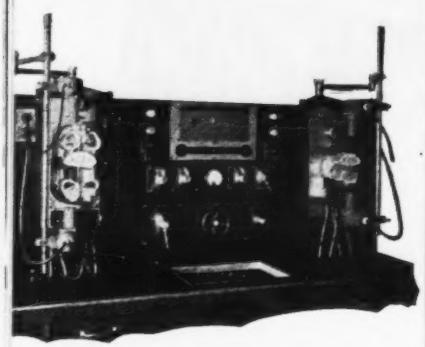

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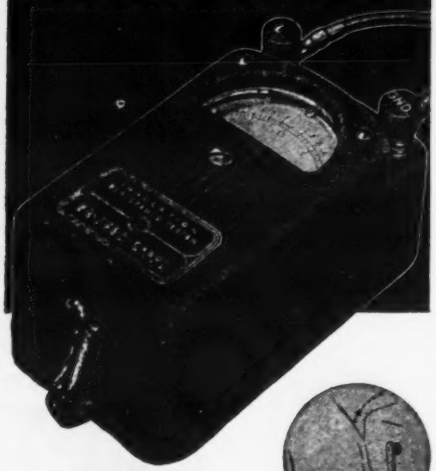
INSULATION
RESISTANCE TESTER



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Portable.

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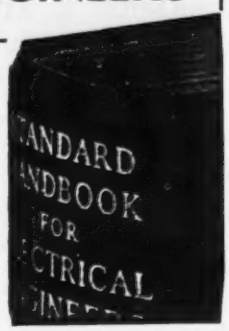

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BOOK REVIEWS

Theory and Applications of Electron Tubes. Herbert J. Reich. Published by McGraw-Hill Book Co., Inc., New York. Illustrated, 716 pages. Price $5.00.

A second edition of the original college text of 1938 with addition of the technology which has grown meanwhile. Practically half the treatment is devoted to the principles of tube behavior and the other half to applications. The diversity of application technique is largely functional rather than episodic, and the practicing electrical engineer can therefore find tangible clues to practicable ways that he may wish to devise to achieve electronically some result hardly approachable by conventional electrical engineering.

Your Servant the Molecule, by Walter S. Landis, published by The Macmillan Co., New York, N. Y., 238 pages, illustrated, price $2.75.

In largely non-technical exploration this book makes intelligible to the layman how the chemist manipulates the raw materials of nature to produce our liquid fuels, resins, rubbers, detergents, colloids, as well as foods, explosives, textiles and drugs. Of primary interest to the technical reader is the simple familiarity that it affords with the meaning of the suffixes, prefixes, compounds and generic names of chemical groups. Why is it meth*ane*, benz*ene*, pyrid*ine*, cyanam*ide*, glycer*ol*? Power salesmen in particular will relish the outline of processes and operations in the chemical industry as set forth by this (now deceased) vice-president of a large chemical corporation.

Occupational Accident Prevention. Harry H. Judson and James M. Brown. Published by John Wiley & Sons, Inc. New York. 234 pages. Price, $2.75.

Notes prepared by the authors for war training courses to supplement the subject matter of prior industrial safety instruction have been expanded into this book of basic cautions and objectives. Precepts of the National Safety Council, ASA, government bureaus, IES and other authoritative sources have been incorporated along with numerous conclusions from a wide variety of accidents. One of the twenty-five chapters deals solely with electrical hazards and another with resuscitation. An appendix reproduces the ASA standard method of compiling industrial injury rates and another lists a considerable number of sound-slide films for safety instruction.

High-frequency Induction Heating, by Frank W. Curtis, published by McGraw-Hill Book Co., New York, N. Y. 231 pages, illustrated. Price $2.75.

Eight of the chapters are devoted to heating of metals (superficially or penetratively) and one to dielectric heating. Treatment is largely non-mathematical, the formulas and quantitative values being largely of the rule-of-thumb type. Unusual care is taken by the author to emphasize the conforming of the coil to the work to achieve the particular quality and quantity of heating. Both industrial electrical engineers and the industrial power salesmen of utilities will find in this prompt book a helpful guide to practical utilization of kilocycles and megacycles in refined and economical heating.

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SUPERINTENDENT — Of Municipally owned electric and water utility in a small Wisconsin city. Complete charge of all operations, including office and purchasing. Non-partisan Board managed. Permanent. Give experience, education, age, personal characteristics and draft status. Mail applications received to: Waterloo Water & Light Commission, Jerome W. Zibell, Secretary, Waterloo, Wisconsin.

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ELECTRICAL ENGINEER, University Graduate, registered professional engineer, 20 years experience as industrial power engineer with large utility, interested in making a change. Would like position as power sales supervisor or assistant to sales manager. Could take charge of electrical maintenance in large industrial plant. Age 45, married, excellent references. Would consider South America or Mexico. PW-794, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

RATE ENGINEER or executive assistant; Thoroughly competent to plan and coordinate post-war rate program. 20 years diversified experience, 9 as head of rate department of large utility, 3½ with regulatory commission, 4½ as utility statistician or accountant, 3 in other lines, including electrical manufacturing. Now employed by regulatory commission. Degree in public utility economics and business administration with 3 years course in electrical engineering. Age 45, available on 30 days notice. Good health, best references. Permanency desired. PW-802, Electrical World, 330 W. 42nd St., New York 18, N. Y.

MAN WITH years of varied utility experience and electrical engineering background desires employment. PW-810, Electrical World, 330 W. 42nd St., New York 18, N. Y.

(Continued on page 232)

COMMERCIAL PILOT

Commercial pilot familiar light and heavy ships desires flying position with engineering or construction firm. 15 years electrical experience utility and industrial companies. Will locate anywhere within reason.

PW-804, Electrical World
520 North Michigan Ave., Chicago 11, Ill.

WANTED

EDITORIAL ASSISTANT

Excellent position is available for technical editor and writer. Man must have thorough knowledge of principles of electrical engineering. Should have facility as a writer and be able to review and to analyze critically the writings of others on engineering subjects. This is a permanent position and offers excellent opportunity to a man with imagination, good engineering background, and writing ability. Starting salary $3600. for applicant who in our judgment fully meets our requirements. Write Supervisor, Technical Employment, 306 Fourth Avenue Pittsburgh, Pennsylvania.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

POSITION AVAILABLE

ENGINEER:

Mechanical electrical, experienced in design layout, research, and testing. Transmission and distribution equipment. Permanent. Applicant must have good technical background. State details of education, experience, draft status, age and availability. Send photo with application and state salary expected. Address reply to:

A. B. CHANCE COMPANY

210 North Allen St., Centralia, Mo.

WANTED

ELECTRICAL ENGINEER

For old established eastern manufacturer. One who can design and manage transformer department, who understands all phases of transformer design and building. Only engineers thoroughly familiar with building and calculating on all types of air and oil cooled transformers need apply. Steady position and good salary to right man.

P-800, Electrical World
330 West 42nd St., New York 18, N. Y.

Interested in Canadian Sales?

Engineering representative with twenty years' experience in Canadian field, and who is covering Eastern Canada regularly calling all utilities and large industrial buyers of electrical equipment, desires additional lines. All inquiries treated in strict confidence. Write Advertiser,

RA-808, Electrical World
330 W. 42nd St., New York 18, N. Y.

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Design Engineer **on Aviation, Marine and Floodlighting equipment—must be able to prepare specifications for manufacture and test of such equipment, also redesign of present equipment. Salary $215 to $300.**

Application Engineer **to analyze proposed illumination projects—must have electrical engineering background and experience on lighting problems. Will be expected to render engineering assistance on negotiations. Salary $215 to $300.**

Write Supervisor of Technical Employment for application, 306 Fourth Avenue, Pittsburgh, Pennsylvania.

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Every Machine in This Ad Is Owned Outright By Us

D C MOTORS

	HP	Make	Type	Volts	Speed
1—	1250	G.E.	MPC	550	160
1—	1200	Whse.	Compen.	550	600/720
1—	800	G.E.	MPC	660	600
1—	625	G.E.	MPC	500	160
1—	600	G.E.	MPC	600	650/900
1—	500	G.E.	MPC	230	900
1—	500	Whse.	Compen.	250	800/720
1—	350	G.E.	MPC	220	450
1—	300	G.E.	MPC	230	275/550
1—	250	Al. Ch.		230	525
1—	200	Whse.		230	400
1—	175	Whse.	SK	250	150/525
1—	150	G.E.	MPC	230	250/450
1—	130	Cr. Wh.	CMC-65H	550	1200
1—	130	Whse.	SK-185	110	450-1340
1—	125	G.E.	CC	230	625
1—	100	G.E.	LC-50	230	1200
1—	100	G.E.	MPC	230	225/450
1—	100	G.E.	RC-38	230	600
1—	75/100	Whse.	SK-183	230	450/900
1—	75	G.E.	LC	230	500/1000
1—	75	Whse.	SK-183	230	560/1100
1—	60	El. Dy.	25S	230	525/1050
1—	50/60	Cr. Wh.	65H	230	500/1000
1—	50	Cr. Wh.	CMC-81H	230	300/900
1—	50	G.E.	RC-19	230	400/1200

TRANSFORMERS

	KVA	Make	PH	Type	Voltage
1—	1667	Pitts	1	OISC	13200x2300
1—	1050	G.E.	3	WCTH	11000x445
1—	525	G.E.	1	HJDD	2300x445
1—	500	Pitts.	1	OISC	13200x2300
1—	333	Moloney	1	C-OISC	22000/11000x2300/575
1—	333	Whse.	1	OISC	2300x460
1—	333	Pitts.	1	OISC	2400x220
1—	300	G.E.	1	H-RP	13200x575/1150/2300
1—	300	Pitts.	3	ODSC	4150x208/120
1—	300	Packard	1	OISC	2200x220/440
1—	200	G.E.	1	H-IDD	2400x115/460
1—	150	G.E.	1	HKS	440x115/230

MOTOR GENERATOR SETS

3 ph. 60 cycle

1—1500 KW GE 275 V. Gen. d.c. to 2100 HP 2300 V.
1—1000 KW G. E. 250 V. DC to 1400 HP 2300 V.
1—500 KW G. E. 250 V. DC to 700 HP—440/2200 V.
1—500 KW GE 600 V. DC Gen. d.c. to 700 HP—2200/13200 V. Syn. Motor with Exciter
1—400 KW GE 250/275 V. Gen. d.c. to 650 HP 2300 V.
1—350 KW G. E. 220 V. AC Gen. d.c. to 500 HP 250 V. DC motor.
1—300 KW GE 600 V. Gen. d.c. to 435 HP—2300 V.
1—250 KW G. E. 250 V. DC to 375 HP—440 V.
1—200 KW Whse. 250 V. Gen. d.c. to 300 HP—2300 V.
1—105 KW GE 70 V. Gen. d.c. to 160 HP—2300 V.
1—100 KW GE 125/250 V. Gen. d.c. to 150 HP—440 V.
1—75 KW GE 125 V. Gen. to 120 HP IK 400/2300.
1—50 KW GE 125 V. Gen. to 75 HP KT 4000/2300 V.

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1—500 KW, Whse. 625 Kva., 440 V., 3 ph., 60 cy., 3600 RPM with Parsons 145/175 lb. condensing turbine complete with jet condenser and accessories.

ROTARY CONVERTERS

60 Cycle

	KW	Make	Speed	D.C. Volts	Trans. Volts
1—	1500	Whse.	720	600	2300
1—	1500	Whse.	600	600	11500
1—	1250	G.E.	720	250	2300
1—	1000	G.E.	900	600	13200
1—	1000	Whse.	900	600	11000
1—	750	G.E.	1200	600	2300
1—	750	Whse.	720	250	6600/2300
1—	500	Whse.	1200	600	13200/2300
1—	375	G.E.	1200	250	6600/2300
2—	300	G.E.	1200	600	2300

25 cycle

2—	1500	G.E.	500	225/275	13200/6600
1—	500	G.E.	750	225/275	13200/6600

All units can be furnished with AC and DC controls.

A. C. MOTORS

3 ph. 60 cycle

Synchronous

	HP	Make	Type	Volts	Speed
2—	2100	G.E.	ATI	2300/4600	514
1—	600	Al. Ch.		2200	720
1—	150	Whse.		4000	1800
1—	100	Whse.	G	2200	1800
1—	75	G.E.	TS-7556	220/440	600

Slip Ring

1—	1200	CR.-Wh.	801-Q	220	237
1—	800	Al. Ch.		440	885
1—	600	G.E.	MT	550	220
2—	600	G.E.	IP	440/2200	720
1—	480	Whse.	CW	2200	875
1—	400	G.E.	IP	440/2200	600
1—	400	Al. Ch.		2300	505
1—	400	G.E.	IP	2200	252
1—	300	G.E.	IM	2300/4000	257
1—	250	G.E.	MT	4000/2300	257
1—	200	Whse.	CW	2200	514
1—	200	G.E.	IM	440	600
1—	150	Whse.	CW-772C	2200	1160
1—	150	G.E.	IM	2200	875

Squirrel Cage

1—	300	Whse.	CS	550	580
1—	300	G.E.	IK	2300	600
1—	175/112	G.E.	IK	440	900/720
1—	125	Whse.	CS	220/440	1150
1—	100	G.E.	IE-13	2200	1800

SYNCHRONOUS CONDENSERS

1—	2000	Whse.		2400	720
1—	1000	G.E.	ATI	2200/3800	900
1—	900	G.E.	ATI	2200/6600	1200
1—	750	G.E.	ATI	220/440	900

RE-NU-BILT BELYEA MOTORS

What are your requirements? units up to 5000 kw available in stock.

BELYEA COMPANY INC.

Main Office & Shop: **51 HOWELL ST., JERSEY CITY, N. J.**

POSITIONS WANTED

(Continued from page 231)

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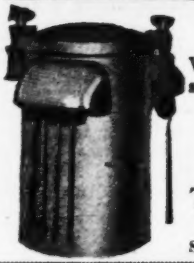

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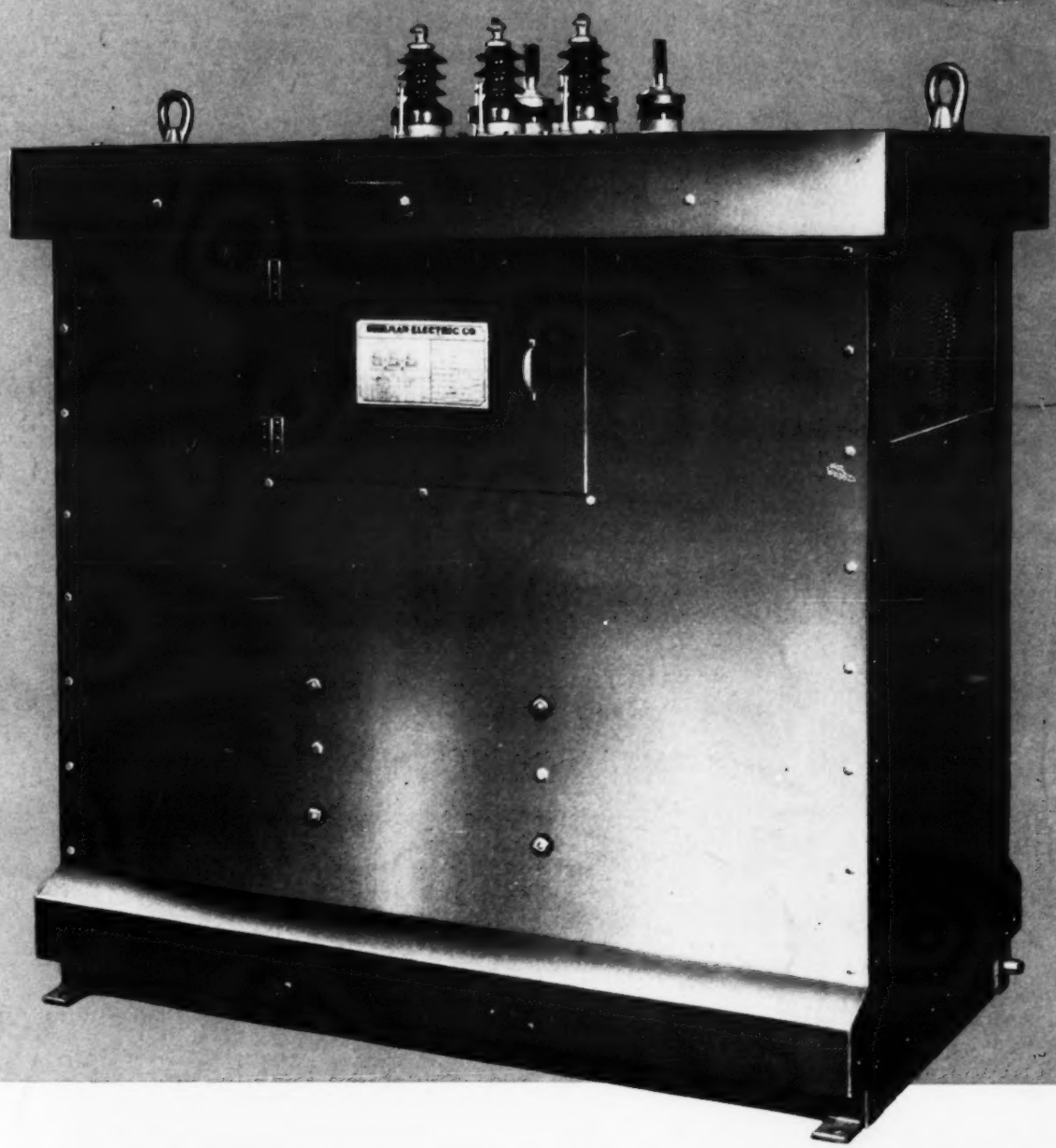

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